User Manual

CANstress

Version 2.1

English

Imprint

Vector Informatik GmbH
Ingersheimer Straße 24
D-70499 Stuttgart

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1 Introduction

In this chapter you find the following information:

1.1 About this user manual

1.1.1 Access helps and conventions

To find information quickly

The user manual provides you the following access helps:

- At the beginning of each chapter you will find a summary of the contents,
- In the header you can see in which chapter and paragraph you are ((situated)),
- In the footer you can see to which version the user manual replies,
- At the end of the user manual you will find an index, with whose help you will quickly find information.

Conventions

In the two following charts you will find the conventions used in the user manual regarding utilized spellings and symbols.

Style	Utilization
bold	Blocks, surface elements, window- and dialog names of the software. Accentuation of warnings and advices. **[OK]** Push buttons in brackets **File** | **Save** Notation for menus and menu entries
CANstress	Legally protected proper names and side notes.
`Source code`	File name and source code.
Hyperlink	Hyperlinks and references.
<STRG>+<S>	Notation for shortcuts.

Symbol	Utilization
	Here you can obtain supplemental information.
	This symbol calls your attention to warnings.
	Here you can find additional information.
	Here is an example that has been prepared for you.
	Step-by-step instructions provide assistance at these points.
	Instructions on editing files are found at these points.
	This symbol warns you not to edit the specified file.

1.1.2 Certification

Certified Quality Management System

Vector Informatik GmbH has ISO 9001:2000-12 certification. The ISO standard is a globally recognized quality standard.

1.1.3 Warranty

Restriction of warranty

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1.1.4 Support

You need support?

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+49 (711) 80670-200

or you send a problem report to the CANoe-Support.

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2 Basics

In this chapter you find the following information:

2.1 Overview of CANstress

Disturbance of the CAN bus

With CANstress the user can cause specific and reproducible disturbances of the CAN bus, its physical properties and the logical level (recessive or dominant).

CANstress offers the following capabilities:

- Forcing of recessive or dominant bus levels
- Simulation of difficult-to-troubleshoot faults
- Disturbance of specific messages
- Manipulation of the bit fields of CAN messages

CANstress variants

The following CANstress variants are available:

- CANstressD (Digital)
- CANstressDR (Digital and Resistor network)

2.1.1 CANstress System Components

Hardware

CANstress consists of a robust hardware module and the CANstress software that is used to configure the CANstress hardware.

The CANstress hardware is fed directly into the CAN bus line to be disturbed using the supplied CAN connection cable. The CANstress hardware is connected to the PC via the serial RS-232 or USB port.

With few CAN nodes and a resulting small terminating resistor, you probably need the included CAN low-speed adapter, when operating CAN low-speed networks. Place this connector between the CAN socket on the CANstress disturbance module and the CAN connector cable.

2.1.2 Functional Features of CANstress

Initiate disturbances

Digital disturbances can be initiated on the CAN bus with CANstressD and CANstressDR. The disturbances that CANstress forces on the CAN bus are user-definable sequences of dominant and/or recessive disturbance pulses. The disturbance pulses can be defined on both the bit level and BTL level.

A trigger is used to initiate the disturbances. The following trigger types are available:

- Bit field trigger
- Start of Frame
- Error Frame
- End of Frame / Bus Idle
- External
- Software

An external output (e.g. for an oscilloscope connection) can also be triggered by these trigger types.

Besides disturbing on the bit level, it is also possible to disturb on the BTL level. In this case the smallest specifiable disturbance does not consist of a complete bit time, rather just one BTL cycle. This makes it possible to partially disturb a bit.

The following disturbance modes are available:

- Unlimited number of disturbances
- Limited number of disturbances
- Continuous disturbance (while trigger)
- Continuous disturbance (until stop)
- Continuous disturbance (time limited)

Bit triggers and disturbance messages may be configured using the symbolic identifiers from a CANdb database.

In addition to the capabilities named above, CANstressDR also has a resistor network and capacitor network with which analog disturbances can be generated on the CAN bus. For example, this makes it possible to simulate line losses in the network and different bus lengths.

With CANstressDR, if a continuous disturbance is active the resistor network can be modified interactively. This allows the user to study gradual changes to the physics of the bus.

2.2 COM Server

Controlling from external programs

With the help of the COM Server you can control CANstress from external programs.

External programs are not just understood to be applications; scripts also come under consideration. Certainly the most well-known script and programming languages available to you for this purpose include: VBScript, JScript, Perl, VBA, Visual Basic, Delphi and C/C++:

- VBScript
- Jscript
- Perl
- VBA
- Visual Basic
- Delphi
- C/C++

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In such cases our disclaimer is not displayed when CANstress is called by a script (or similar).

Cross reference: You can find detailed information of the COM server in the online help.

2.3 Installation of the CANstress Software

Note: You need administrator rights to install the software!

Requirements of the PC

Your PC must fulfil the following requirements to permit installation and execution of the CANstress software:

- IBM-compatible PC
- Processor: Pentium 2
- Working memory (RAM): at least 512 MB
- Operating system: Microsoft Windows 2000, XP or Vista
- USB or RS232 port

Installation

Proceed as follows to install the CANstress software:

1. Insert the installation CD in your CD drive.
2. Call up the installation program SETUP.EXE.
3. Folgen Sie den Anweisungen des Installationsprogramms.

Note: The language of the menus and dialogs can be switched at any time after the installation (See VECTOR.INI on page 13)

2.4 Startup of the CANstress Hardware

Connections:

The following connections must be made for startup:

Connection to the PC

- Connection via USB port:

  With the included USB cable, which has a four-pole connector for the connection to CANstress on one side, a connection to the PC is established.

- Connection via serial RS-232 port:

  The RS 232 control interface of the CANstress hardware is connected to an available COM port on the PC using the DB-9 extension cable provided. If the PC port is not equipped with a 9-pin connector, rather with a 25-pin connector, then a 9-to-25 pin adapter should be added to the PC end of the cable.

Connection to CAN

The bus is opened at any suitable point, preferably at a CIA-conformant DB-9 connection; this is where the CAN adapter cable is fed into the bus. The 15-pin connector of the adapter cable is then plugged into the CAN port of the CAN-stress hardware.

Connection to the current supply

A supply voltage of 8 to 40 VDC is fed to the CANstress hardware's supply connector using the cable provided or over a customer-specific cable.

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2.5 INI Files

Oveview

INI files are usually ASCII text files that contain configuration options for application programs.

The names in square brackets (for example `[Language]` in the INI file `VECTOR.INI`) refer to individual sections of the INI file in which the options can be configured.

Comment lines in the INI files are identified by // at the beginning of the line, and they describe the available options.

Note: The sequence of sections within a INI file and the sequence of options within a section are irrelevant.

Within INI files upper/lower case font is irrelevant.

The INI files are located in the `%COMMONAPPDATA%\Vector\CANstress` directory. By default with Win2000 and WinXP `%COMMONAPPDATA%` corresponds to `<drive of windows installation>\Documents and Settings\All Users`. With Windows Vista `%COMMONAPPDATA%` corresponds to `<drive of windows installation>\Program Data\Vector\CANstress`.

The `Vector.INI` file can only be changed with administrator rights.

Change settings

Proceed as follows to change the options in a INI file:

1. Open the INI file with an ASCII editor.
2. Change the options as desired. For example, if you wish to change the language of menus and dialogs in `VECTOR.INI` you would replace the numeric language identifier entered in the line `Country=` in the section `[Language]` with the identifier for the desired language.

   Example:

   The following entry causes menus and dialogs to appear in English:
   ```
   [Language]
   Country=01
   ```
3. Save the INI file and close the editor.

Note: If CANstress was opened during editing, you must exit CANstress and then reopen it to have the new configuration take effect.

2.5.1 VECTOR.INI

Settings

The following options can be configured in `VECTOR.INI`:

- Language of the menus and dialogs (section `[Language], line Country=`)
- Path in which the CANdb Editor is installed (section `[CANdb], line Path=`)

Note: If the language of your version of Windows does not agree with the language set for CANstress some dialogs and buttons will appear in the language of your Windows version.

For example, if you have set English as the language for CANstress under a German version of Windows, the German "Öffnen" ("Open") dialog appears, since Windows resources are referenced here.

2.5.2 CANstress.INI

Settings

The following options can be configured in `CANstress.INI`:

- Last opened configuration (section `[AppInfo], line LastConfig=`)
- Serial port of the computer to which the CANstress hardware is connected (section `[Local Settings], line ComPort=`)
- Baudrate at which communications occur between the computer and the CANstress hardware (section `[Local Settings], line BaudRate=`)
- List of last opened configurations (section `[Recent File List]`)

Maximum disturbance voltage

This entry only applies to devices of the type CANstressDR; it does not affect devices of the type CANstressD.

In the file `CANstress.ini` there is the following INI entry:

```
[Hardware]
ExactDistVoltage=12
```

`ExactDistVoltage` gives the maximum disturbance voltage that is fed or may be fed to the CANstress hardware. The default entry is 12 (Volt).

The value given as `ExactDistVoltage` is used to calculate loads of resistors R_H, R_HL and R_L on the Analog Board and to decide wither your selected resistor values may be transferred to the hardware, or whether they could potentially result in hardware damage. (See also “Resistor validation“)

If you feed in a different disturbance voltage please observe the following instructions:

- The maximum allowable disturbance voltage that may be applied to the hardware is 40 V.
- The disturbance voltage you are applying must be entered in the INI entry `ExactDistVoltage`!

```
[Hardware]
ExactDistVoltage=12
```

Note: You should never specify a disturbance voltage in the INI entry that is lower than the voltage you actually apply to the device! Otherwise the hardware might be permanently damaged! Make sure that the INI entry `ExactDistVoltage` is always configured correctly.

Resistor validation

This entry only applies to devices of the type CANstressDR; it does not affect devices of the type CANstressD.

The resistor settings are validated before the configuration that is set at the CAN-stress user interface is downloaded to the hardware. This involves checking whether the current settings may be transferred to the hard-ware, or whether they could result in potential hardware damage. If there is a risk of hardware damage, transfer of the configuration to the hardware is aborted.

To ensure that the validation process will detect potential hardware damage and pre-vent transfer of the configuration that could result in damage, the voltage applied as the disturbance voltage must be entered in the INI entry `ExactDistVoltage`!

If you do not make any changes to the hardware the 12 V supply voltage is also used as the disturbance voltage. Therefore, the entry `ExactDistVoltage=12` already has already been made in CANstress.INI.

Note: If you make changes to the CANstress hardware and feed in a disturbance voltage that is different from the delivered state, you must enter it in the `ExactDistVoltage` entry of the CANstress.INI file! Under no circumstances should the disturbance voltage you apply be greater than the disturbance voltage given in `ExactDistVoltage`! Otherwise the hardware could be permanently damaged! Make sure that the INI entry `ExactDistVoltage` is always set correctly.

Note: Resistor validation is performed immediately before transferring the configuration to the hardware, if resistor R_H is connected to V_D+ and R_L is connected to V_D- (or reversed) and both R_H and R_L are connected.

In resistor validation the resistors R_H, R_HL and R_L are subjected to a check.

First, a determination is made to determine the individual resistances in a resistor matrix (see Technical data of the CAN disturbance module) of which the resistor is composed.

Afterwards a calculation is made to determine how much power is dissipated by the individual resistors when the voltage specified in `ExactDistVoltage` is applied. If the power dissipation at an individual resistor is greater than the maximum allowable loading for the individual resistor, this is recognized as an unallowable state, and transfer of the configuration to the hardware is not permitted.

Display of the CAN baudrate and the CAN bus type

After the disturbance start, the toolbar displays:

- ➔ which CAN baudrate is set
- ➔ which CAN bus type (high-speed, low-speed) is used. The CAN bus type is acquired from the information of the used CAN interface.

This information is used to check whether suitable CAN settings are used.

The display of this information is limited to a defined time and can be controlled via an entry in the CANstress.ini file:

```
[AppInfo]
// Period of time (in ms) for which the CAN information is
displayed in the toolbar.
ShowCanInfo=5000
Mit ShowCanInfo=0 lässt sich die Anzeige abschalten.
```

2.6 Filename Extensions

A filename extension refers to the three characters located after the dot following the file name. The filename extension identifies the file type.

Filename extension	File type
CNT	Table of contents for Help files (Contents)
CST	CANstress configuration
DBC	Database (Data Base for CAN)
DLL	Runtime library (Dynamic Link Library)
EXE	Executable Program
CHM	Help file (Help)
INI	File with configuration options

2.7 Keyboard Operations (Shortcuts)

Key(s)	Operation	Command
<Ctrl>+<O>	Opens a configuration.	"Open" ("File" menu)
<Ctrl>+<N>	Creates a new configuration.	"New" ("File" menu)
<Ctrl>+<S>	Saves the active configuration.	"Save" ("File" menu)
<Esc>	Closes the active dialog without accepting the changes. (Corresponds to activation of the **[Cancel]** button or **[Close]**.) If trigger and disturbance systems are activated: Deactivates the trigger and disturbance systems.	"Stop" ("Disturbance" menu)
<F1>	Calls CANstress help for the active dialog or selected command. If CANstress help is active: Calls Help texts containing information on using and configuring Help.	
<F3>	Selects the **external output** selection list in the toolbar. In this list you can select the trigger for the external output.	
<F4>	Back to the active window. With this shortcut you can (re)set the focus on the active window, after selecting the trigger for the disturbance or the external output (with the aid of <F2> or <F3>).	

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Key(s)	Operation	Command
<F8>	Initiates a software trigger or activates/deactivates software level triggering.	"Trigger" ("Disturbance" menu)
<F9>	Establishes a connection to the CANstress hardware and activates the trigger and disturbance systems.	"Start" ("Disturbance" menu)
<F10>	Activates the main menu bar.	
<Alt>+<F4>	Closes the active configuration and exits CANstress.	"Exit" ("File" menu)
<Alt>+Space	Opens the System menu of the CANstress program window. Alternatively the System menu could also be opened by double clicking the System icon.	
<Ctrl>+<Tab>	Activates the next page of the CANstress program window. The menu pages can also be activated with the commands of the "View" menu.	
<Ctrl>+<Shift>+<Tab>	Activates the previous page of the CANstress program window. The menu pages can also be activated with the commands of the "View" menu.	
<Tab>	In pages or dialogs: Selects the next user control element (Control).	
<Shift>+<Tab>	In pages or dialogs: Selects the previous user control element (Control).	
Spacebar	In pages or dialogs: Activates or deactivates an option box.	
Arrow keys	If an option box is selected in pages or dialogs: Selects the next option.	

2.8 Sample Configurations

Configurations: The following sample configurations are included with the CANstress software:

Disturb-SOF-Bit.cst With this configuration the Start Of Frame Bit is disturbed by a recessive bit.

Disturb-SOF-Bit-With-BTL.cst With this configuration the 1st BTL cycle in the Start Of Frame Bit is forced to a recessive level.

Disturb-AbsData-ID.cst With this configuration the message ABSData (from the DBC database `motbus.dbc`) is disturbed. CANstress overwrites the 11th bit in the ID by a dominant bit.

Error-Frame-On-SOF.cst	With this configuration an Error Frame is triggered by a Start Of Frame.
Error-Frame-On-AbsData-ID.cst	With this configuration an Error Frame is triggered once when the ID of the message ABSdata (from the DBC database `motbus.dbc`) occurs.
Trigger-Extern-Output-On-Error-Frame.cst	With this configuration the external trigger output is set to the **High** level when an Error Frame occurs, e.g. to trigger an external device.
Error-Frame-On-Extern-Trigger.cst	With this configuration an Error Frame is initiated as soon as a Low->High edge occurs at the external trigger input.
Disturb-ACK-on-ID.cst	With this configuration the dominant bit in the ACK slot - which receivers of the message ABSdata (from the DBC database `motbus.dbc`) send out as acknowledgment that the message was received - is disturbed recessively.
Disturb-ACK-on-Different-ID.cst	With this configuration, for all transmitted messages of the node ABS (from the DBC database `motbus.dbc`) the dominant bit in the ACK slot - which receivers of these messages send out as confirmation that the message was received - is disturbed recessively. The Bit Field Trigger condition for this case is obtained by starting the "Selection of Messages" dialog on the "Bit Field Trigger" page and selecting all Tx messages of the node ABS by clicking and simultaneously pressing the <CTRL> key. After pressing **[OK]** the resulting trigger condition is constructed and displayed for the selected messages (ABSdata, WheelInfo, WheelInfoIEEE). (Afterwards the ACK slot must be cleared to ensure that the trigger condition also ends before the ACK slot).
Multi-Disturb-With-Pause.cst	With this configuration an Error Frame is placed on the bus when a Start Of Frame is detected. This occurs five times within one disturbance cycle. Afterwards the bus is left undisturbed for 10 ms. In this time period the bus can recover, and the error counters of the nodes are decremented by correct receipt and transmission of messages.
ABSdata-Bus-Off.cst	With this configuration the sender of the message ABSdata is intentionally put into the Bus-Off state.
Trigger-On-Certain-Datafield.cst	With this configuration both the disturbance and the external trigger output are triggered as soon as a message occurs which contains '0011 xx00' in its 3rd data byte (i.e. the 5th and 6th bits can have any arbitrary contents). This trigger condition can essentially only be fulfilled by messages whose DLC>=3.
Send-Msg-With-CRC-Error-On-Bus-Idle.cst	With this configuration, during Bus-Idle a message is sent out whose last bit in the CRC sequence is corrupted to '1' instead of '0'. This permits testing of whether a receiver detects this CRC error. The disturbance sequence was created by starting on the "Disturbance" menu page of the Disturbance Sequence Wizard, pressing the **[Message]** button in the "Disturbance Message" dialog that opens and selecting the message ABSdata by double clicking it. Before exiting the dialog with **[OK]** the last bit of the CRC sequence was also changed from '0' auf '1' and the CRC delimiter was cleared.

2.9 CANstress Online Help

CANstress provides a comprehensive online Help function which can be called from the "Help" menu, the **[Help]** button or the <F1> key.

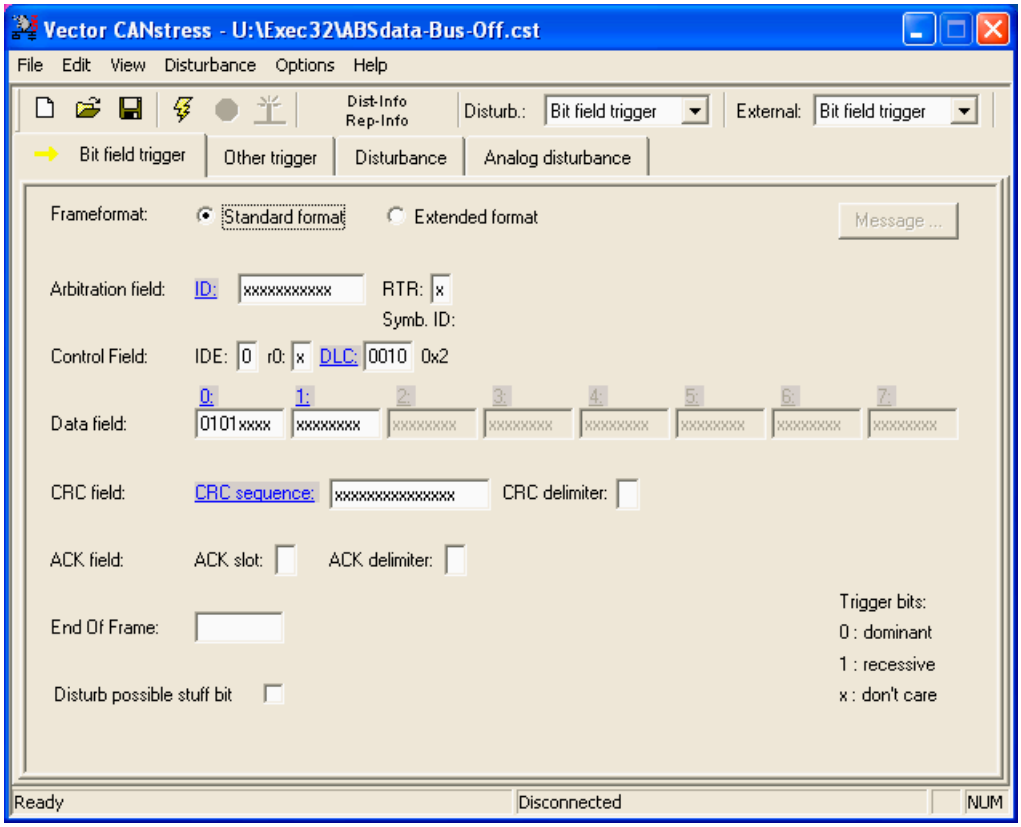
Cross reference: If you choose the "Using Help" command ("Help" menu) or press the <F1> key while CANstress online Help is active, you get information on using and configuring the online Help function.

3 CANstress Software

In this chapter you find the following information:

3.1 CANstress Program Window

Screenshot



3.1.1 Title Bar

Display of the configuration

The title bar of the CANstress program window contains, in addition to the CANstress system symbol, the name of the currently active CANstress configuration.

3.1.2 Main Menu Bar

Basic functions

The main menu bar is located directly below the title bar on the CANstress program window.

3.1.3 Toolbar

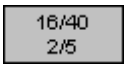
Quick access to commands

The icons arranged on the toolbar allow the user quick access to frequently used commands. The toolbar is located beneath the menu bar in the CANstress program window. Clicking an icon causes the associated command to be executed.

Symbol	Command
	"New file" ("File" menu)
	"Open file" ("File" menu)
	"Save" ("File" menu)
	"Start" ("Disturbance" menu)
	"Stop" ("Disturbance" menu)
	"Trigger" ("Disturbance" menu)

Display of the current disturbance state

Next to the icons the toolbar contains a box which displays the current disturbance state, and list boxes for selecting the trigger source for the disturbance system and the external output.

Element	Explanation
	Box for user visualization of the momentary disturbance state. As soon as disturbances are generated information on the disturbances appears here.
	The trigger source for the disturbance system can be selected here.
	The trigger source for the external output can be selected here.

Dist-Info (upper line)

In the 'Limited number of disturbances' and 'Unlimited number of disturbances' disturbance modes, appearing instead of "Dist-Info" is the number of disturbances per-formed. After the slash is the total number of disturbances to be performed. (The total number of disturbances to be performed is calculated as follows: Number of disturbances per disturbance cycle * Number of disturbance cycles.) Displayed in the 'Continuous disturbance' disturbance mode is how often the continuous disturbance was switched on and off.

Rep-Info (lower line)

n the 'Limited number of disturbances' mode, appearing instead of "Rep-Info" is the number of disturbance cycles performed. After the slash is the total number of disturbance cycles to be performed. In the 'Unlimited number of disturbances' and 'Continuous disturbance' modes '0/1' always appears here, since in these two modes there is only one disturbance cycle which however is never run through completely.

3.1.4 Status Bar

The status bar is located along the lower border of a window.

Inforamtion about command

If the mouse pointer is located above an icon in the CANstress program window, or if a command is selected, then a brief description of that command appears in the **left status bar box**.

Connection status:	Displayed in the **middle box** is information on the current connection status to the CANstress hardware:
Disconnected	There is no connection between the CANstress hardware and the CANstress software.
Connected at ... baud	CANstress hardware and CANstress software are connected; communication occurs at the indicated baud rate.
Transmit at new baud rate ...	If the baud rate was changed in the "Connection Parameters" dialog while a connection existed between the hardware and software, this status line appears briefly. The CANstress software attempts to establish a connection at the changed baud rate.
Connect over COM ... at ... baud	The CANstress software attempts to establish a connection to the CANstress hardware over the specified serial port and at the indicated baud rate.
Connected via USB with ...	With an existing connection via USB the unit number of the connected CANstress unit is displayed.
Connection layer ready	The connection layer between the CANstress software and CANstress hardware is ready to establish a connection.
Key status	The **boxes on the right** side of the status bar offer information on the status of the user-selectable keys: ➔ "INS" The <Ins> key is activated. ➔ "NUM" The <Num> key is activated ('Num Lock' LED illuminates).

3.2 Pages

3.2.1 "Bit Field Trigger" Page

Bit field trigger	Defined here are the contents of bit fields for triggering on message contents. For this there various trigger bits are available.
Frame format	The message format (Standard or Extended) is set here.
Chosse message	After activating the **[Message]** button, the message on which to trigger can be selected in the "Selection of Messages" dialog. Since the data bytes of a selected message are not prescribed, those input fields and the CRC Sequence input field are filled with don't care bits. If you wish to trigger on a group of CANdb messages, it is also possible to make a multiple selection in the "Selection of Messages" dialog. This involves combining these messages with one another to come up with a resulting message, whereby the bit positions that do not agree are given a don't care bit.

Example: Message 1 begins with '1101....'. Message 2 begins with '1100...'. In this case the first four bits of the resulting message yield '110x' in order to satisfy the trigger condition for both '1100' and for '1101'.

Note: The **[Message]** button is only active if one or more DBC databases were associated to the active configuration. (Use the "Associate database" command ("File" menu) to associate DBC databases to the active configuration.

Bit input fields

The input boxes in the Bit Field Trigger window can essentially be filled with '0' (dominant), '1' (recessive) or 'x' (don't care). Selected bits can be edited together with commands of the "Edit" menu or commands of the popup menu.

The end of the trigger condition is defined by the last specified bit. For example, if the input field for the CRC sequence only contains one bit, the trigger condition also ends with this bit.

In evaluating the bit field trigger condition by the hardware, all bits up to the last specified bit are used in the comparison with the received bit sequence (from which the stuff bits were removed) - even if the last bits were specified as don't care bits. Consequently, the earliest the disturbance sequence can be initiated is after the last bit of the trigger condition (see also "Disturb any stuff bit" in this context).

The bit field trigger condition is satisfied if the received bit sequence agrees with the care bits ('0' or '1') in all bit positions.

Note: The bit field trigger condition that is given to the hardware is a combination of all editable input fields: e.g. if a Data Length Code (DLC) is specified as '0001', then only one data field is editable. Only this field is used for the trigger condition, while the seven remaining non-editable data fields are not considered in triggering (even if they are not empty).

For specific edit fields the input of values via the "Hex/Dec input" dialog is possible now.

Automatic filling or clearing of input fields

All bits from the beginning of a message to the last bit of the trigger condition must be specified. Therefore, input fields which lie 'before' the end of the trigger condition but are not completely filled are supplemental filled up with don't care bits as soon as the cursor disappears from the input field in which the last entry was made. 'Before' means that from the receiver's perspective the bits belonging to this input field would be received before the end of the trigger condition.

For example, if an empty bit field trigger condition is entered beginning with the DLC, it is assumed that the previous bits do not play any role in the formulation of the trigger condition, and accordingly the associated input fields are filled with don't care bits (with the exception of the IDE bit input field).

Since the trigger condition is ended by the last specified bit, all input fields that come 'after' an incompletely filled input field are cleared. In this context 'After' means that from the receiver's perspective the bits associated with these input fields would be received after the last bit of the trigger condition.

For example, if the input field for the DLC was not completely filled, among other things all subsequent input fields for data bytes would be emptied of entries.

Disturb possible stuff bit

Essentially it is possible for a stuff bit to occur after the specified trigger condition. The "Disturb possible stuff bit" option can be used to decide whether or not a stuff bit occurring after the trigger condition should be disturbed.

For example, if you only wish to disturb the dominant RTR bit of a CAN data frame in Standard format with a recessive disturbance bit, you would use only don't care bits for the ID as the trigger condition and also deactivate the "Disturb possible stuff bit" option. Otherwise the disturbance sequence (consisting of only one bit) would only disturb a stuff bit if one occurred.

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On the other hand, if you wish for example to intentionally disturb the stuff bit that occurs if the ID of a message begins with five recessive bits, you would specify five recessive bits ('1') in the ID input field as the trigger condition and activate the "Disturb possible stuff bit" option.

Special input fields:

IDE

The input field for the IDE bit has some special characteristics. These are related to its role in specifying whether the hardware interprets the received bit stream as a message in Standard format or as a message in Extended format.

In Standard format the IDE bit can only assume the values '0' (dominant) or 'x' (don't care). If 'x' is entered for the IDE bit, it is not possible for the hardware to properly interpret the bit stream beyond the IDE bit. For this reason, when a don't care IDE bit is entered it is also not possible to specify a bit field trigger condition that goes beyond the IDE bit. This also applies to messages in Extended format.

For the same reasons, in Extended format the IDE Bit may only assume the values '1' (recessive) or 'x' (don't care).

RTR

Here the user defines whether triggering should occur on Data frames (dominant RTR bit) or on Remote frames (recessive RTR bit) or on both types (don't care RTR bit).

If a recessive bit is specified in the "RTR" input field, the input fields for the data bytes are disabled for user input, since no data bytes are sent with a Remote frame, and they also may not be used in the evaluation of the trigger condition.

If a don't care bit is specified in the "RTR" input field, all data bytes that result from evaluation of the DLC input field are enabled for user input. When don't care bits are entered in the input fields for data bytes, triggering occurs on both Data frames and Remote frames. However, if a care bit is given in a data byte the hardware only triggers on messages which also contain this care bit, and therefore there is no triggering on Remote frames.

DLC

Here the user specifies how many data byte input fields are editable. If a valid value is entered (i.e. a DLC from 0 to 8) in the DLC input field, then the relevant input fields for the data bytes are enabled or disabled accordingly. For example, if a DLC of 1 is entered (i.e. '0001') then the input field for the 1st data byte is enabled and all others are disabled for user input.

When don't care bits are entered in the DLC input field, the maximum possible DLC is calculated from these bits and the data byte input fields are enabled or disabled accordingly.

Note: If four don't care bits are entered in the DLC input field, and the eight edit-able input fields for the data bytes are also filled with don't care bits, then the hardware triggers on messages that have 0 to8 data bytes.

On the other hand, if four don't care bits are entered in the DLC input field, and a care bit is entered in the 8th editable data byte, the hardware only triggers on messages that actually have this care bit in the 8th data byte. That is, in this case triggering never occurs on messages having fewer than eight data bytes!

If an invalid DLC is specified in the DLC input field (e.g. '1111') no further (meaningful) support can be provided for displaying the proper data fields. In this case all eight data fields are enabled for user input (since this is a case of a DLC > 8).

CRC Sequence

If all input fields up to the input field for the CRC sequence are filled without don't care bits, it is possible to have this field automatically filled with the appropriate CRC code.

To do this, place the cursor over the "CRC Sequence" input field and then choose the "CRC Sequence" command ("Edit" menu). Alternately the same command could be accessed from the popup menu.

3.2.2 "Other Trigger" Page

Remaining triggers: Located here are the configuration fields for the remaining triggers.

Error flag

The number of dominant bits n (n=6 to 12) for an Error frame's error flag specifies how many dominant bits must occur in the error flag to cause triggering.

For n=6 triggering occurs as soon as an Error frame is detected. For n=12 triggering occurs when the superimposed error flags of different network nodes yield an error flag with 12 dominant bits (see also: Triggering on Error Frame on page 46)

End of Frame/Bus-Idle trigger

The number of recessive bits n (n=8 to 18) specifies how many recessive bits must follow after a dominant bit (dominant ACK slot, see below) to cause triggering. For n=8, for example, triggering occurs after a message's End of Frame (n=8: One recessive bit of the ACK delimiter + seven recessive bits of the End of Frame), provided that there is more than one node in the network: Only if there are a receiver and a sender in the network the sender's recessive bit in the ACK slot is overwritten by a dominant bit by the receiver.

For the case where only one node (sender) exists in the network, it can only be assured that the bus is in the Bus Idle state after 17 consecutive recessive bits.

Explanation: Since no dominant ACK slot occurs the following is possible: Up to 4 recessive bits (at the end of the CRC sequence) + 1 recessive bit (CRC delimiter) + 1 recessive bit (ACK slot!) + 1 recessive bit (ACK delimiter) + 7 recessive bits (End of Frame) + 3 recessive bits (Intermission) yield 17 recessive bits in succession.

In this case bit field triggering could also be used.

(See also FAQ Overview on page 78: How do I trigger on End of Frame if there is only one node (Sender) in the network?)

In a normal network with sender(s) and receiver(s), on the other hand, it can be assured after 11 consecutive recessive bits that the bus is in the Bus Idle state. After 1 dominant bit (ACK slot) there follows 1 recessive bit (ACK delimiter) + 7 recessive bits (End of Frame) + 3 recessive bits (Intermission).

(See also: Triggering on End of Frame / Bus Idle on page 47)

External input

With the external input it is possible to define whether the input should be used as an external trigger or as a trigger enable signal.

When used as an external trigger the user can choose whether the input should be a Level trigger (with LOW or HIGH level) or an Edge trigger (with triggering on the transition from LOW->HIGH or HIGH->LOW).

When used as a trigger enable signal, the user can decide whether, when a trigger condition is satisfied, there must also be a low (LOW) or high (HIGH) voltage level at the input to permit triggering.

(See also: Triggering by External Input on page 47)

Software trigger

With the software trigger the user can configure whether it should act as an Edge trigger or as a Level trigger.

If the software trigger is used as an Edge trigger, the trigger icon on the toolbar behaves like a conventional icon. When used as a Level trigger the icon appears alternately as 'not pressed' and as 'pressed'. Similarly, in this case a ✔ or no ✔.

(See also: Triggering by Software on page 47)

Continuous trigger

The Continuous trigger is triggered immediately after disturbance start (**Disturbance|Start**).

- → With the "Unlimited duration" option, the continuous trigger will only be switched off when the disturbance ends (**Disturbance|Stop**).
- → With the "Duration" option, you can set the time after which the continuous trigger will be ended automatically. The time-controlled continuous trigger can only be ended prematurely by selecting **Disturbance|Stop**.

Note: The trigger sources "Continuous trigger" and "Software" cannot be used simultaneously since the continuous trigger is already implemented in the program as a software trigger.

For the Continuous trigger, the "as trigger enable" setting of the external input will not be considered or used.

3.2.3 "Disturbance" Page

Disturbance

The disturbance mode is selected here (see Disturbance Mode on page 50) and the disturbance sequence is defined.

Disturbance modes:

For the disturbance bits, various disturbance states can be defined.

Unlimited number of disturbances

In the 'Unlimited number of disturbances' disturbance mode, a disturbance is executed for each trigger event. The total number of triggered disturbances is unlimited.

Limited number of disturbances

In the 'Limited number of disturbances' disturbance mode, the number of disturbances n within a disturbance cycle is limited. After n disturbances have been executed a configurable pause p is inserted, unless there is only a single disturbance cycle. The number of disturbance cycles to be performed is also configurable.

Continuous disturbance (while trigger)

In the 'Continuous disturbance (while trigger)' disturbance mode a disturbance is only executed during the time period in which the trigger condition is satisfied. For this reason this disturbance mode is only advisable for Level triggering (software trigger with Level triggering or external trigger with Level triggering).

Continuous disturbance (until stop)

The 'Continuous disturbance (until stop)' disturbance mode is an expansion of the Continuous disturbance disturbance mode. Here the bus with a configurable disturbance mode (dominant, recessive or analog) can be disturbed continuously too. The disturbance begins with **Disturbance|Start** and continues until **Disturbance|Stop**.

Continuous disturbance (time-limited)

The 'Continuous disturbance (time-limited)' disturbance mode is an expansion of the Continuous disturbance disturbance mode. In addition to a disturbance mode (dominant, recessive or analog), a duration for the disturbance can be selected. Upon occurrence of a trigger event, the continuous disturbance will be placed on the bus for the specified duration.

Disturbance type for continuous disturbance

The disturbance types permitted for the continuous disturbance are dominant, recessive or (in the DR variant) analog disturbance. The disturbance lasts as long as the trigger condition is satisfied.

Disturbing with limited number of disturbances

When disturbing with a limited number of disturbances the user can set the number of disturbances n (n=1 to 255) per disturbance cycle. For the number of disturbance cycles m the user can set a value between 1 and 65535 or infinite. The Infinite value (shown in the display as 'inf') may be set by entering an alpha character or by decrementing the number of disturbance cycles.

If more than one disturbance cycle should be executed, the user can also configure a pause p between 1 ms and 65535 ms, which is inserted after n disturbances have elapsed. During this pause no trigger conditions are evaluated (for the disturbance), and therefore no disturbance is triggered.

Disturbance sequence

The disturbance sequence is composed of a sequence of disturbance states. The user may enter the following values for disturbance states: '0'(dominant), '1'(recessive), 'u'(undisturbed) and (in the DR variant) 'a'(analog). Using the "Edit" menu or the context-sensitive menu, the appropriate bit state for marked bits can be selected.

Depending on whether the selected resolution is BTL cycles or bit times, one disturbance state refers either to the duration of one BTL cycle or the duration of one bit time.

The length of the disturbance sequence may assume a value n where n=1 to 2048.

The analog disturbance state is configured on the "Analog disturbance" page.

The Undisturbed disturbance state is not actually a disturbance state, since it does not influence the state on the bus. Nevertheless it is needed for example to intentionally shift the start of the disturbance by n physical bits or BTL clock cycles, where n is the number of undisturbed disturbance states at the beginning of the disturbance sequence (FAQ Overview on page 78:How can triggering of a disturbance be delayed?).

Cross reference: The Disturbance Sequence Wizard provides support in creating disturbance sequences ("Disturbance Sequence for Bit Field Trigger" Dialog on page 41, "Disturbance Message" Dialog on page 42, "Disturbance Sequence" Dialog on page 42, "Error Frame" Dialog on page 43)

3.2.4 "Analog Disturbance" Page

Note: The "Analog disturbance" page is only available with CANstressDR!

Analog disturbance

The resistor and capacitor network for analog disturbance pulses is defined here. Analog disturbance pulses may be caused by the following in a real CAN network:

- Short circuits
- Isolation faults
- Poor contacts

The Capacitor C_HL acts in opposition to the resistances at the disturbance start. Its effect ends with the disturbance stop.

The Resistances act only as long as an analogous disturbance state (‘a’ in the disturbance result) is on the bus.

The following disturbance parameters may be used to configure the disturbance state:

- R_HL for simulating contact resistances between wires (e. g. isolation faults, humidity, short circuits)
- R_H for simulating contact resistances to disturbance voltages
- R_L for simulating contact resistances to disturbance voltages

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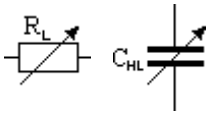
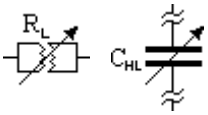
- R_SH for simulating length resistances in wiring (e. g. poor contacts or line breaks)
- R_SL for simulating length resistances in wiring (e.g. poor contacts or line breaks)
- C_HL for simulating longer bus lines at low baudrates (only makes sense for Low-Speed buses)

Connecting and Disconnecting Disturbance Parameters

Essentially the individual disturbance parameters can be connected or disconnected by clicking the relevant component in the circuit diagram. However, in defining a layout (see below) the resistors are subject to certain restrictions. If a resistor is disconnected the associated input field, in which the user enters a resistor value for this resistor, is disabled for user input.



Connected components



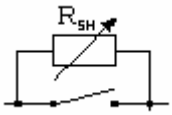
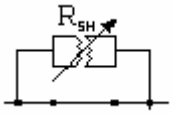
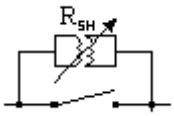
Disconnected components

The Capacitor C_HL will be activated in the graph after disturbance start and influences the CAN bus until disturbance stop.

States of the resistances R_SH and R_SL

Requirement: CANstressDR with current firmware (as of version 1.23)

The resistances R_SH and R_SL can have the following three states:

Status	Graphic
Series resistance in the CAN line: R_SH (R_SL) normal in operation	
Switched off: R_SH (R_SL) deactivated and associated switch closed	
Break of the CAN line: R_SH (R_SL) deactivated and associated switch open	

In order to disconnect the CANH line during an analog disturbance, it is necessary to click on the RSH resistance until R_SH is deactivated AND the switch below it is opened.

Limitations

Please be advised that the line disconnection for the individual resistance layouts is subject to particular limitations:

Layout	Possible line disconnection
Standard	R_SH (CANH), R_SL (CANL)
R_H, R_SH, R_HL (without R_SH)	R_SL (CANL)
R_L, R_SL, R_HL (without R_SL)	R_HL (CANH)

Layout	Possible line disconnection
R_H and R_SL, R_H and R_L, R_SH and R_HL, R_SH and R_SL, R_SH and R_L, R_HL and R_SL, R_HL and R_H, R_HL and R_L	-

Disturbance voltage

By default the supply voltage and disturbance voltage are jumpered together in the supply connector. However, the disturbance voltage can also be fed in separately.

In the circuit diagram the user can specify whether the resistor should be connected to the positive (V_D+) or negative (V_D-) pole of the disturbance voltage; this is done by clicking the switch next to R_H or R_L.

The maximum disturbance voltage that may be used, and which is utilized to check the configured layout, is displayed next to "Max. disturbance voltage".

Note: The allowable disturbance voltage range given in the technical data must be observed, since otherwise the equipment could be destroyed!

Maximum disturbance voltage

This entry only applies to devices of the type CANstressDR; it does not affect devices of the type CANstressD.

In the file "CANstress.ini" there is the following INI entry:

```
[Hardware]
ExactDistVoltage=12
```

`ExactDistVoltage` gives the maximum disturbance voltage that is fed or may be fed to the CANstress hardware. The default entry is 12 (Volt).

The value given as `ExactDistVoltage` is used to calculate loads of resistors R_H, R_HL and R_L on the Analog Board and to decide wither your selected resistor values may be transferred to the hardware, or whether they could potentially result in hardware damage. (See also “Resistor validation “)

If you feed in a different disturbance voltage please observe the following instructions:

- → The maximum allowable disturbance voltage that may be applied to the hardware is 40 V.
- → The disturbance voltage you are applying must be entered in the INI entry `ExactDistVoltage`!

Note: You should **never specify a disturbance voltage** in the INI entry **that is lower than the voltage you actually apply to the device**! Otherwise the hardware might be permanently damaged! Make sure that the INI entry `ExactDistVoltage` is always configured correctly.

Resistor layouts:

Besides the Standard layout the following resistor layouts can be defined.

Resistor Layouts	Description
Standard-Layout	When using the Standard layout none of the resistors may be changed while the hardware is activated. Therefore, as soon as the hardware is active all user controls for modifying resistor values (input fields, rotary fields and sliders) are disabled.

Resistor Layouts	Description
Layout R_H	When using the layout R_H the resistor R_H can be changed during an active disturbance. This involves deactivating resistor R_SH, and the hardware connects it internally to R_H.
Layout R_SH	When using the layout R_SH the resistor R_SH can be changed during an active disturbance. This involves deactivating resistor R_H, and the hardware connects it internally in parallel to R_SH.
Layout R_HL (without R_SH)	When using the layout R_HL (without R_SH) the resistor R_HL can be changed during an active disturbance. This involves deactivating resistor R_SH, and the hardware connects it internally in parallel.
Layout R_HL (without R_SL)	When using the layout R_HL (without R_SH) the resistor R_HL can be changed during an active disturbance. This involves deactivating resistor R_SH, and the hardware connects it internally in parallel.
Layout R_SL	When using the layout R_SL the resistor R_SL can be changed during an active disturbance. This involves deactivating resistor R_L, and the hardware connects it internally in parallel to R_SL.
Layout R_L	When using the layout R_L the resistor R_L can be changed during an active disturbance. This involves deactivating resistor R_SL, and the hardware connects it internally in parallel to R_L.
Layout R_H and R_SL	When using the layout R_H and R_SL the resistors R_H and R_SL can be changed during an active disturbance. This involves deactivating resistors R_SH and R_L and connecting them in parallel to R_H and R_SL.
Layout R_H and R_L	When using the layout R_H and R_L the resistors R_H and R_L can be changed during an active disturbance. This involves deactivating resistors R_SH and R_SL and connecting them in parallel to R_H and R_L.
Layout R_SH and R_HL	When using the layout R_SH and R_HL the resistors R_SH and R_HL can be changed during an active disturbance. This involves deactivating resistors R_H and R_SL, and the hardware connects them internally in parallel to R_SH and R_HL.
Layout R_SH and R_SL	When using the layout R_SH and R_SL the resistors R_SH and R_SL can be changed during an active disturbance. This involves deactivating resistors R_H and R_L, and the hardware connects them internally in parallel to R_SH and R_SL.
Layout R_SH and R_L	When using the layout R_SH and R_L the resistors R_SH and RL can be changed during an active disturbance. This involves deactivating resistors R_H and R_SL, and the hardware connects them internally in parallel to R_SH and R_L.

Resistor Layouts	Description
Layout R_HL and R_SL	When using the layout R_HL and R_SL the resistors R_HL and R_SL can be changed during an active disturbance. This involves deactivating resistors R_SH and R_L, and the hardware connects them internally in parallel to R_HL and R_SL.
Layout R_HL and R_H	When using the layout R_HL and R_H the resistors R_HL and R_H can be changed during an active disturbance. This involves deactivating resistors R_SL and R_SH, and the hardware connects them internally in parallel to R_HL and R_H.
Layout R_H and R_L	When using the layout R_H and R_L the resistors R_H and R_L can be changed during an active disturbance. This involves deactivating resistors R_SH and R_SL, and the hardware connects them internally in parallel to R_H and R_L.

The Standard layout differs from the other resistor layouts in that it is not possible to adjust resistor values while the hardware is activated.

For all other layouts at least one resistor can be changed even if the disturbance system is active. Nevertheless at least one other resistor must be deactivated as well. This requirement is based on the condition that when changing resistor values (during an active disturbance), the transition to the new resistor value must take place without any timer periods when a resistor value is undefined. Since one of the resistors is not used in the resistor layout, internally the hardware can connect this resistor in parallel to the resistor to be changed. The resistor value is changed while the hardware is active by alternately having one of the resistors active while the other is passive and adjusting to the new resistor value. After successfully changing the passive resistor to the new resistor value, it is activated, and the previously activated resistor is simultaneously deactivated.

With the exception of the Standard layout, the names of all other layouts indicate which resistor can be changed while the hardware is activated.

Automatic checking of resistors

Before the resistor layout is loaded in the hardware, a check is made to determine whether the configured resistor values could result in hardware damage. This check involves resistors R_H, R_HL and R_L, in the case where R_H is connected to VD+ and R_L to VD- (or reversed). If the current configuration could result in hardware damage, this is output in the form of a warning message, and the transfer is prevented. In this case, using commands from the "Edit" menu the user can determine the next closest resistor value at which this resistor is no longer at risk for damage.

During an active disturbance it is possible that changing the value of one of the resistors R_H, R_HL or R_L could pose a risk for the hardware. If such a value is set at the user interface, it is not transferred to the hardware and the resistor identifier in front of the input field is shown in red (otherwise, if the new value does not pose a risk, it is shown in black).

To inform the user of the values that are set in the hardware, the individual resistor values are shown beneath "Resistor values in the hardware" while the hardware is active. The resistor values shown at these places are the last values reported to the user interface by the hardware.

Changing the resistance values when the hardware is activated

If a resistor is changed very quickly during an active disturbance (e.g. using a slider) the hardware buffers the requested settings for the resistor and will only switch over to the most recently requested resistor value approx. every 100 ms.

3.3 CANstress Menus

3.3.1 "File" Menu

Commands: The "File" menu contains the following commands:

New
Creates a new configuration.

Note: If the active configuration contains unsaved changes, before creating the new configuration a dialog box appears asking the user whether the changes should be saved.

Open
Opens the "Open" dialog in which the user can select the configuration to be opened. The file type 'CANstress (*.cst)' (CANstress configuration) is automatically selected.

After selecting the configuration to be opened and pressing the **[Open]** button the configuration is opened and displayed in the CANstress program window.

Note: If the active configuration contains unsaved changes, before opening an-other configuration a dialog box appears asking the user whether the changes should be saved.

Save
Saves the active configuration.

Note: If the active configuration was never saved before, a "Save as" dialog appears in which the memory location and filename can be entered for the configuration. The file type 'CANstress (*.cst)' (CANstress configuration) is automatically selected.

After selecting the memory location, entering the filename and pressing the **[Save]** button the configuration is saved.

Save as
Opens the "Save as" dialog where the user can specify the memory location and filename under which the active configuration should be saved. The file type 'CANstress (*.cst)' (CANstress configuration) is automatically selected.

After selecting the memory location, entering the filename and pressing the **[Save]** button the active configuration is saved under the selected name.

Associate Database
Opens the "Databases" dialog in which one or more CANdb databases can be associated to the active configuration.

Note: The message information of a CANdb database cannot be used in a CANstress configuration until the database has been associated to the configuration.

Exit
Closes the active configuration and exits CANstress.

Note: If the active configuration contains unsaved changes, a dialog box appears asking the user whether the changes should be saved.

Located above the "Exit" command is the list of last opened configurations. The desired configuration can be opened by clicking its name.

3.3.2 "Edit" Menu

Commands dependent on pages: The "Edit" menu will contain different commands depending on which page of the CANstress program window is activated.

"Bit field trigger" page

- "Recessive"

  Sets the selected bit or bits to the value '1' (recessive).
- "Dominant"

  Sets the selected bit or bits to the value '0' (dominant).
- "Don't Care"

  Sets the selected bit or bits to the value 'x' (don't care).
- "Clear"

  Deletes the selected bit or bits.
- "CRC sequence"

  Calculates the CRC sequence for the bit fields beginning with the Start of Frame up to the last valid data field and inserts the calculated CRC sequence in the "CRC Sequence" input field.

Note: The "CRC sequence" command is only available if the input fields that are relevant for the CRC calculation (i.e. all input fields before the "CRC sequence" input field) do not contain any 'don't care' bits.

"Other trigger" page

- "Recessive"

  Sets the selected bit or bits to the value '1' (recessive).
- "Dominant"

  Sets the selected bit or bits to the value '0' (dominant).
- "Don't Care"

  Sets the selected bit or bits to the value 'x' (don't care).
- "Clear"

  Deletes the selected bit or bits.

"Disturbance" page

- "Recessive"

  Sets the selected bit or bits to the value '1' (recessive).
- "Dominant"

  Sets the selected bit or bits to the value '0' (dominant).
- "Analog"

  Sets the selected bit(s) or the selected BLT cycle(s) in the "Disturbance sequence" input box to the value 'a' (analog).

Note: The 'Analog' disturbance state is only available with CANstressDR!

- "Undisturbed"

  Sets the selected bit(s) or the selected BTL cycle(s) in the "Disturbance sequence" input box to the value 'u' (undisturbed).
- "Clear"

  Deletes the selected bit or bits.

"Analog disturbance" page

- "Valid RH"

  Finds a resistor value for resistor RH, at which the resistor RH is not at risk for damage, and inserts the determined value in the "RH" input box.

- "Valid RHL"

  Finds a resistance value for resistor RHL, at which the resistor RHL is not at risk for damage, and inserts the determined value in the "RHL" input box.

- "Valid RL"

  Finds a resistor value for resistor RL, at which the resistor RL is not at risk for damage, and inserts the determined value in the "RL" input box.

Note: The "Analog disturbance" page is only available with CANstressDR!

The commands of the "Edit" menu can also be accessed from the popup menus of the bit input fields.

3.3.3 "View" Menu

Commands:

The "View" menu contains the following commands for activating the pages of the CANstress program window

- "Bit field trigger"
- "Other trigger"
- "Disturbance"
- "Analog disturbance" (only available with CANstressDR)

3.3.4 "Disturbance" Menu

Commands:

In the "Disturbance" menu the following commands are available:

Connect

Establishes a connection to the CANstress hardware.

The user can select the port and baud rate for this connection in the "Connection Parameters" dialog. (Use the "Connect" command ("Options" menu) to open the "Connection Parameters" dialog.)

If it is not possible to establish a connection, the message "Unable to establish connection to the disturbance module" appears, which the user must confirm with **[OK]**.

Note: The status bar shows information on the connection to the CANstress hardware.

Disconnect

Disconnects the CANstress hardware.

Start

The following actions are executed after choosing the "Start" command:

- A check is made to determine whether the active configuration is valid.
- A connection is established to the CANstress hardware (unless this has already been done with the "Connect" command ("Disturbance" menu)).
- The active configuration is transferred to the CANstress hardware.
- The trigger and disturbance system is activated.

Trigger	If the "Edge" option was selected in the "Software trigger" box of the "Other trigger" page, this command initiates a single software trigger. However, if the "Level" option was selected, this command toggles level triggering on and off.

Note: The "Trigger" command is only available if the software trigger was selected as a trigger source!

As long as level triggering is activated:

- ➔ Trigger events continue to be initiated,
- ➔ A appears in front of the "Trigger" command,
- ➔ The corresponding Toolbar icon appears as though it were pressed.

Stop	Deactivates the trigger and disturbance system. The CANstress hardware remains connected.

3.3.5 "Options" Menu

Commanbds:	The "Options" menu contains the following commands:
CAN interface	Opens the "CAN Interface" dialog in which the CAN interface is defined.
CAN parameter	Opens the "Channel Configuration" dialog in which parameters are set for the CAN interface.
External output	Opens the "External Output" dialog in which the user can select the voltage level that the external output should assume when the trigger condition is satisfied.
Connect	Opens the "Connection Parameters" dialog in that parameters are defined that are relevant for connecting the CANstress hardware to the computer.
Other…	Opens the "Further Settings" dialog in which a frequency deviation can be set for CANstress.

3.3.6 "Help" Menu

Commands:	The "Help" menu contains the following commands:
CANstress Help F1	Calls CANstress help.
About	Opens the "About CANstress" dialog which contains information on the CANstress software and CANstress hardware.

3.4 CANstress Dialogs

Overview	The following dialogs can be opened by the commands or buttons of the CANstress software.

3.4.1 "CAN Interface" Dialog

Define CAN interface	The CAN interface is defined here.

Open dialog

Use the "CAN Interface" command ("Options" menu) to open this dialog.

Interfaces

The CANstress hardware has the following CAN interfaces:

CAN-Interface 1	Is permanently installed and contains a transceiver for connecting to a CAN High-Speed Bus
CAN-Interface 2	(Optional) is implemented in the hardware by an inter-changeable baby board. The only baby board currently available has a Low-Speed transceiver.

With an existing connection to the CANstress hardware instead of "CAN Interface 1" and "CAN Interface 2" the bus type of the interface and its used transceiver is displayed.

Note: The specific transceiver type installed can be found in the "About CANstress" dialog after establishing a connection. (Use the "About" command ("Help" menu) to open the "About CANstress" dialog. With the [More Info] button you can get information about the CANstress hardware)

3.4.2 "Channel Configuration" Dialog

Configure channels

Parameters for the CAN interface are set here.

Open dialog

Use the "CAN Parameters" command ("Options" menu) to open this dialog.

CAN channel 1

In the "CAN Channel 1" box, which appears on the right side of the dialog immediately after opening it, the user specifies the CANstress variant, the controller (SJA1000 from Philips) and the baud rate, and the CANstress hardware is displayed.

Note: The configuration options are the same as the configuration options that are familiar from CAN controllers, whereby each bit is essentially sampled only once.

The CANstress hardware itself does not contain any controller.

CAN channels

Appearing in the "CAN channels" display box is "CAN 1", which represents the available CAN channels. Clicking the symbol causes "Setup" to appear beneath the CAN channel. Clicking or the word "Setup" causes the "CAN Setup 1" box to appear on the right side, in which the user can configure the baud rate and the Bus Timing Registers.

Note: The options apply to both CAN channels, i.e. both CAN interfaces.

Baudrate

The user enters the baudrate here.

After entering a different baud rate and pressing the <Tab> or <Enter> key, or clicking in another input box, the corresponding register values are calculated and entered in the appropriate input boxes. The "BTR 0 | BTR 1 | Sampling point | BTL cycles | SJW" table contains the allowable register pairings (see below).

Bus Timing Register 0 or Bus Timing Register 1	The Bus Timing Registers determine how an individual bit in a serial bit stream is constructed on the bus, and where it is sampled. Allowable values for the Bus Timing Registers can be taken from the "BTR 0 | BTR 1 | Sampling point | BTL cycles | SJW" table (see below) and are selected by clicking in the table.
Acknowledge On	The option shown in this option box is fixed and cannot be changed.
Clock Frequency	The clock frequency is fixed and cannot be changed.
BTR 0 | BTR 1 | Sampling Point | BTL Cycles | SJW	In this table appears all register pairings BTR 0-BTR 1 permitted for CANstress together with the sampling point (in percent of bit duration after the beginning of the bit), number of BTL cycles and the synchronization jump width (SJW). A number of different Bit Timing Register pairings exist for any given baud rate, which determine CANstress behavior with regard to the sampling point, number of BTL cycles and synchronization jump width (SJW).

Note: A soft synchronization of CANstress occurs exclusively on arriving edges from recessive to dominant and based on the synchronization jump width (SJW) set in the "Channel Configuration" dialog.

A hard synchronization occurs on SOF bits (Start Of Frame bits), i.e. on recessive->dominant edges after a minimum of 10 recessive bits.

After clicking a line in the table the values of the Bus Timing Registers are automatically entered in the appropriate input boxes.

Preview synchronization edge	The option set here does not have any effect whatsoever on the CANstress software or hardware!
Samples	The number of samples is determined by selection of the Bus Timing Register, and it cannot be configured, since for CANstress only those combinations of BTR 0 and BTR 1 are permitted which yield a single sample.
Prescaler	Shown here is the prescaler resulting from the register values.

3.4.3 "External Output" Dialog

Define voltage level	Here the user selects the voltage level to be assumed by the external output when the trigger condition is satisfied.
Open dialog	Use the "External output" command ("Options" menu) to open this dialog.

3.4.4 "Connection Parameters" Dialog

Define connction parameters	Here the user defines parameters relevant to connecting the CANstress hardware to the computer.
Open dialog	Use the "Connect" command ("Options" menu) to open this dialog.

Seriel connection

Under Serial connection the connection parameters for the serial (RS-232-) interface can be set.

Port

Here the user selects the serial port of the computer to which the CANstress hardware is connected.

Note: The port cannot be changed if a connection already exists between the computer and the CANstress hardware.

Baudrate

Here the user sets the baud rate at which communications occur between the computer and the CANstress hardware.

Note: As long as the connection exists between the computer and the CANstress hardware, the settings of the interface (port, baudrate,…) can not be changed.

On some computers problems may occur at a baudrate of 115,200 Baud when establishing a connection. In this case the CAN-stress software automatically sets a baudrate that is suitable for communications.

The connection via USB has a higher priority than the connection via the serial RS-232 interface. Thus a connection to a unit is established as soon as the unit is connected via USB (even if the unit is also connected via the serial RS-232 interface).

USB interface

For the USB interface no connection parameters must be set. A (CANstress) unit connected via USB will be automatically identified and used.

If a connection is done via the USB interface the unit number of the connected CANstress unit is displayed in the status bar.

3.4.5 "Disturbance Sequence for Bit Field Trigger" Dialog

Generate disturbances for bit field trigger

With this wizard (Disturbance Sequence Wizard on page 51) disturbances can intention-ally be generated within a CAN message. These disturbances are triggered with bit field triggering.

Additionally, the wizard displays the trigger condition defined on the "Bit field trigger" page. This portion of the wizard cannot be edited, and it only appears for display purposes. The end of the non-editable portion is indicated by a '|'. The actual disturbance can be input after this symbol.

Note: The format of the message for which a disturbance can be specified is the same as the format of the message specified in the bit field trigger condition.

All input fields up to the CRC sequence must be filled with care bits, e.g. to have the program offer to calculate the CRC sequence, and so that it can be calculated.

Only care bits may be used in the bit field trigger condition to allow the program to calculate any occurring stuff bits and to insert them into the disturbance sequence!

The wizard can only be started if there is a non-empty bit field trigger condition (i.e. at least one bit must be specified in the bit field trigger condition).

The wizard can only be started if the bit field trigger condition is not completely filled (i.e. at least the input field for End of Frame is not completely filled).

The wizard is only available if the configuration is associated to at least one database.

Example: To disturb the CRC sequence of a specific message, the message is specified on the "Bit field trigger" page up to the last data field (with care bits!). After calling the Wizard for creating a disturbance for bit field triggering, the CRC field can be filled with the calculated CRC sequence. To have this done choose the "CRC Sequence" command in the CRC field's popup menu. The bit to be disturbed in the CRC sequence can then be changed.

3.4.6 "Disturbance Message" Dialog

Create disturbance message

With this wizard (Disturbance Sequence Wizard on page 51) the user can create an entire disturbance message which, for example, might be initiated by the Start of Frame trigger. The disturbance message might even be a message conforming to the CAN specification, and in a strict sense it would then not really represent a disturbance.

The disturbance message can be specified analogous to the "Bit field trigger" page by manually filling the individual bit fields. In contrast to the specification of the bit field trigger condition, don't care bits cannot be used since they do not represent any valid disturbance status.

As an alternative, the user could select the disturbance message by pressing the **[Message]** button in the "Selection of Messages" dialog. Only one message at a time may be selected here, since a composition of multiple messages is not possible.

The data fields of the selected message are displayed according to the message's DLC and are filled with recessive disturbance bits. The CRC sequence is calculated for these data fields accordingly. Therefore, the CRC sequence must be updated after a change to the data fields.

If an invalid value (e.g. '1111') is specified for the DLC it is not possible to interpret the data fields in a meaningful way. In this case all data fields are displayed for editing.

In addition to the entries from the edited input fields, when exiting the wizard (with **[OK]**) a dominant Start of Frame bit is added at the beginning of the disturbance message to complete it.

3.4.7 "Disturbance Sequence" Dialog

Create a disturbance sequence

Using this dialog, a disturbance sequence consisting of bits/BTLs can be created with the same disturbance mode.

Whether the sequence created is a sequence of bits or BTLs depends on the resolution set for the disturbance result on the Disturbance page.

In this dialog, you can enter:

- the Disturbance mode
- The disturbance Length with number of bits or BTL cycles
  After this, the disturbance duration is displayed automatically.
  The calculation occurs with the help of the CAN parameters set in the Channel configuration dialog box.
  The length of the disturbance sequence is (basically) limited to 2048.
- The disturbance Duration in µs After this, there is an automatic conversion to the number of bits or BTL cycles that are required to disturb within this duration.
  Possible min. and max. values for the disturbance duration are displayed below the Duration input field.

Note: The duration can only be set in discrete values (as multiples of the duration of a bit or a BTL cycle). Authoritative for the duration of the disturbance is the number of bits (BTL cycles) in connection with the CAN parameters set.

For min. and max. of the disturbance duration for disturbance results based on bits, the following applies:

- Minimum (for length in bits) = 1 / Baudrate (= duration of a bit)
- Maximum (for length in bits) = 2048 * 1 / Baudrate (= duration of 2048 bits)

For min. and max. of the disturbance duration for disturbance results based on BTL cycles, the following applies:

- Minimum (for length in BTLs) = 1 / (Baudrate * BTLperBit) (= duration of a BTL cycle)
- Maximum (for length in BTLs) = 2048 * 1 / (Baudrate * BTLperBit) (= duration of 2048 BTL cycles)
  BTLperBit is thus the number of BTL cycles per bit, which results from the CAN parameter settings.

3.4.8 "Error Frame" Dialog

Create a disturbance sequence

Using this dialog box, a disturbance sequence, which is equal to an error frame, can be created.

The disturbance sequence can be generated from an error flag with n dominant bits (6 <= n <= 12) and an error delimiter consisting of 8 recessive bits.

If the "Error frame with error delimiter" option is deactivated, the disturbance sequence is created only from the error flag.

3.4.9 "Databases" Dialog

Assign databases

Here you can associate one or more CANdb databases to the active configuration.

Open dialog

Use the "Associate database" command ("File" menu) to open this dialog.

Assign a database to a configuration

The message information from a CANdb database cannot be used in a CANstress configuration until the database has been associated to the configuration.

Note: The association of databases performed here only affects the active configuration. Associations in all other configurations are independent of this action.

Database list

The display box in this dialog contains a list of databases which are associated to the active configuration. The sequence of databases in the list is utilized to resolve conflicts when there are ambiguous symbolic names or message identifiers.

"Name" Column

Indicates the name of the database. This name might be used as a name qualifier to resolve ambiguities.

"CAN" Column

Indicates which CAN chip is assigned to the database. This information is irrelevant for CANstress, since only one CAN interface is active at any given time.

"Filename" Column

Indicates the database's complete filename and path.

Schaltflächen

The following buttons are available in the dialog.

Button	Function
[Add]	Opens the "Open" dialog in which the user can select the CANdb database to be associated to the active configuration. The file type 'CANdb files (*.dbc)' (CANdb database) is automatically selected. After selecting the CANdb database and pressing the [Open] button the selected database is associated.
[Open Editor]	Starts the CANdb Editor and opens the selected CANdb database.
[Delete]	Removes the selected database from the list, i.e. afterwards this database is no longer associated to the active configuration. The database file itself is not deleted by this action.

3.4.10 "Selection of Messages" Dialog

Select messages

Messages can be selected here.

Appearing in the list are the messages of CANdb databases that were associated to the active configuration. (Use the "Associate database" command ("File" menu) to associate CANdb databases to the active configuration.)

3.4.11 "Hex/Dec input" Dialog

Value format

This dialog enables you to enter the values on the "Bit field trigger" page in either hexadecimal or decimal format.

Open and close the dialog

To open this dialog box, just click the underlined text on the page.

When the dialog is closed, the entered value is converted internally into a binary number. Finally, as many digits as possible are taken over into the corresponding input field, beginning with the lowest digit.

Example: The ID in the standard format consists of 11 digits.

If on the "Hex/Dec input" dialog, "0x10" is entered and the dialog is closed with **[OK]**, the corresponding binary number "10000" is written in the ID input field as "00000010000". Since not all 11 places of the input field were required for the entered number, the leading (higher value) places were filled with "0".

If the entered number requires more digits in binary code than can be entered into the input field, then the "n" lowest value places of the binary number are written in the input field.

n = number of characters that can be entered into the input field

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Note: When switching from decimal to hexadecimal, the entered value is converted into the other format and displayed. Thus values up to 2147483647 (0x7fffffff) can be converted correctly. Only then the dialog can be ended with **[OK]**.

3.4.12 "About CANstress" Dialog

Information about CANstress

The following information about the CANstress software and CANstress hardware is displayed:

- Version number of the CANstress software
- Copyright
- Hardware information (with the **[More Info]** button)

  (e.g. transceiver type used for CAN Interface 1 or 2, device variant connected (CANstressDR with analog board to generate analog disturbances or CANstressD without analog board), and the firmware version used by the CANstress hardware)

Note: The hardware information is not exchanged between the CANstress hardware and CANstress software until a connection is established.

If the message "No hardware information available" appears in the "Hardware Information" display box, then no connection was made between the hardware and software.

(The connection between hardware and software can be established with the "Connect" command ("Disturbance" menu).)

Use the "About" command ("Help" menu) to open this dialog.

3.5 Trigger Sources

Initiator of a trigger event

A trigger source serves as the initiator of a trigger event. The trigger event is initiated as soon as the trigger condition specified for the trigger source has been satisfied.

The user can select a trigger from the list of available trigger sources for a disturbance and/or the external output. This selection is made in the "Disturbance" and "External" list boxes on the toolbar.

Trigger sources

The following trigger sources are available as triggers:

- Triggering on CAN bit fields
- Triggering on Start of Frame
- Triggering on Error Frame
- Triggering on End of Frame / Bus Idle
- Triggering by external input
- Triggering by software (user interface)
- Triggering by "Continuous trigger" (for disturbances and external output)
- Triggering "Like disturbance" (only for the external output)

A trigger source can be used both to initiate a disturbance and to activate the external output. It should be noted that a trigger source may only be configured once. For example, both the disturbance and external output could be triggered by an Error frame. However, the user may only make an entry one time for the Error frame's error flag indicating how many dominant bits it must contain to cause triggering.

Basic information on the trigger disturbance cycle

Once a trigger condition is satisfied the disturbance is started.

The trigger conditions are evaluated (if the hardware is activated) when a disturbance has ended or has not been executed yet (i.e. immediately after activation of the hardware).

A pause after a disturbance cycle also counts as part of the disturbance, i.e. no trigger conditions are evaluated during this time period.

Time point of initiation of disturbance as a function of the trigger source

The trigger source used (for the disturbance) also determines the exact time point of disturbance initiation, i.e. the start of the disturbance action.

With bit field triggering, Error frame triggering and End of Frame/Bus Idle triggering the disturbance is initiated after the end of the last bit time of the trigger condition. This means that the disturbance begins with the first BTL clock of the next bit time.

With Start of Frame triggering the disturbance is initiated immediately after detection of the recessive->dominant edge. The disturbance begins with the first BTL clock after this edge.

With triggering by the external input and with software triggering the disturbance is initiated asynchronously. That is, as soon as the trigger condition is satisfied the disturbance is initiated without waiting for the end of a bit time.

3.5.1 Triggering on CAN Bit Fields (Bit Field Trigger)

Bit feld trigger

The bit field trigger is initiated when the specified bit field trigger condition is satisfied. The bit field trigger condition defines how the bit fields of a CAN message must be laid out to satisfy the trigger condition. When specifying the bit field trigger condition any occurring stuff bits are not considered. For a bit within the trigger condition the user can specify whether it must be a dominant or recessive bit to cause triggering. If the user wishes to have triggering occur independent of whether a dominant or recessive bit occurs at a specific position, a don't care bit can be used for this bit in the trigger condition.

3.5.2 Triggering on Start of Frame

Start of Frame trigger

The Start of Frame trigger is initiated when a recessive-dominant edge is detected after Bus Idle (10 or more recessive bits). In contrast to the other CAN trigger sources, triggering here is not initiated after the end of the specific bit, rather it occurs immediately. In this context immediately means it is ensured that the BTL cycle occurring immediately after the Start of Frame edge can also be disturbed, although the disturbance may be somewhat shortened for this cycle.

3.5.3 Triggering on Error Frame

Error Frame trigger

The Error frame trigger is initiated when the Error frame trigger condition is satisfied. The trigger condition for the Error frame defines how many dominant bits the Error frame's error flag must contain to cause triggering.

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3.5.4 Triggering on End of Frame / Bus Idle

End of Frame / Bus Idle trigger

The trigger condition for End of Frame triggering specifies how many recessive bits must follow after a dominant bit to cause triggering. The user can set a value between 8 and 18 for the number of recessive bits. For a system with and least one sender and receiver this is the number of recessive bits that follow the dominant bit of the ACK slot (which was sent by the receiver to acknowledge receipt of a message).

For End of Frame / Bus-Idle triggering with 8 recessive bits, for example, triggering occurs when - after the dominant bit of the ACK slot (of a receiver) - the ACK delimiter (1 recessive bit) and the subsequent End of Frame (7 recessive bits) have occurred.

Actual End of Frame / Bus-Idle triggering is obtained for a trigger condition with 11 recessive bits: Here triggering occurs when - after the dominant bit of the ACK slot (of a receiver) - the ACK delimiter (1 recessive bit), End of Frame (7 recessive bits) and Intermission (3 recessive bits) have occurred.

While it is assured in a network with (at least) two nodes (sender and receiver) that the bus will be in the Bus Idle state after 11 recessive bits, for a network with only one node this is only assured after 17 recessive bits (See also "Other Trigger" Page on page 28, section "End of Frame/Bus-Idle Trigger").

3.5.5 Triggering by External Input

Triggering via external input

Triggering may also be performed via the external input of the CANstress hardware. To do this, the state or state change that should be used to cause triggering is configured over the CANstress user interface.

The following options are available for se-lection:

- Low
  (Voltage level for Low: See Technical Data of the CANstress Hardware)
- High
  (Voltage level for High: See Technical Data of the CANstress Hardware)
- Low->High (Triggering on transition from Low to High)
- High->Low (Triggering on transition from High to Low)

Note: If the external input on the toolbar is selected as a trigger source, the external input is used automatically as an external trigger on the Other Trigger page. Thus the external input can not longer be used as a trigger enable signal.

If the external input is not used for triggering, it can be used as a trigger enable signal. The trigger enable signal is a supplemental condition for triggering. Only if the actual trigger condition AND the trigger enable signal occur simultaneously does triggering occur. A low (LOW) or high (HIGH) level may be selected for the trigger enable signal.

3.5.6 Triggering by Software

Software trigger

The software trigger can be initiated from the user interface. The user configures whether the trigger condition is satisfied for only a brief time (Edge triggering) by choosing the "Trigger" command, or whether the trigger condition remains satisfied until the command is chosen again (Level triggering).

3.5.7 Triggering by "Continuous trigger"

Continuous trigger

The "Continuous trigger" is triggered immediately after disturbance start (**Disturbance|Start**).

With the "Limited duration" option, the continuous trigger will only be switched off when the disturbance ends (**Disturbance|Stop**).

With the "Duration" option, you can set the time after which the continuous trigger will be ended automatically. The time-controlled continuous trigger can only be ended prematurely by selecting **Disturbance|Stop**.

Note: The trigger sources "Continuous trigger" and "Software" cannot be used simultaneously since the continuous trigger is already implemented in the program as a software trigger.

For the "Continuous trigger", the "as trigger enable" setting of the external input will not be considered or used.

Purpose

The "Continuous trigger" can be used immediately after **Disturbance|Start** to disturb the bus continuously, for example with an analog disturbance, or to cause error frames.

With the "Duration option", a time can be specified which, in connection with the "Continuous disturbance (while trigger)" disturbance mode, creates a disturbance for precisely the specified duration.

3.5.8 Triggering "Like disturbance"

Trigger external output with each disturbance

The trigger source "Like disturbance" can only be used for the external output.

With use of this trigger, the external output is triggered with each triggering of a disturbance. If all disturbances or disturbance cycles have been executed, it will no longer be triggered.

Example:

- If you want to disturb the message with the ID 0x100 precisely once on its first occurrence, then enter the ID 0x100 as trigger condition for the bit field triggering and enter "Limited number of disturbances" in the disturbance mode. For the number of disturbance cycles and for the number of disturbances (per cycle), select 1.
- If you want to watch precisely this one case with the oscilloscope, then trigger the oscilloscope via the external output and select "Like disturbance" as the trigger source.
- If, by contrast, you want to trigger the external output (or the oscilloscope) on each occurrence of the ID 0x100, then you must select the "Bit field trigger" for the external output since with this trigger condition triggering will still occur even when there is no more disturbance.

Note: The use of the trigger source "Like disturbance" requires a CANstress firmware Version 1.23 or higher.

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3.6 Disturbances (Disturbance Actions)

Influence of the bus

When the user exercises a defined type of influence on the CAN bus by means of the CANstress hardware this is referred to as a Disturbance. A user-defined (disturbance) pause after a disturbance sequence is therefore just as much a part of a disturbance as the disturbance sequence itself.

The following disturbance states can be generated on the bus with CANstress:

- dominant
- recessive
- analog (only in the CANstressDR version)
- undisturbed

Disturbance sequence

The disturbance states may be combined on both the BTL and Bit levels to create a disturbance sequence. The length of the disturbance sequence is limited to 2048 bits or BTL cycles. Only one disturbance state may be used within one bit time (for definition of the disturbance sequence on the bit level) or within one BTL clock time (for definition of the disturbance sequence on the BTL level).

'dominant' disturbance state

With the 'dominant' disturbance state a state is produced on the bus which corresponds to a dominant bit according to the hardware interface used (Low-Speed or High-Speed).

'recessive' disturbance state

Similarly, with the 'recessive' disturbance state a state is produced on the bus which corresponds to a recessive bit according to the hardware interface used (Low-Speed or High-Speed). That is, a dominant bit sent by a network node can be 'over-written' by a recessive disturbance bit.

'analog' disturbance state

With the 'analog' disturbance state a state is produced on the bus which can be parameterized by a resistor matrix and a capacitor matrix and an external disturbance voltage. This state can be used to simulate external disturbances (e.g. line losses).

'undisturbed' disturbance state

The 'undisturbed' disturbance state is actually not a disturbance state at all, since it leaves the existing bus state unaffected. However, in some applications it may be needed within a disturbance sequence to leave individual bits undisturbed on the CAN bus.

3.6.1 Time Point of Disturbance

Trigge the disturbance

The exact time point at which a disturbance is initiated or the disturbance action is started (e.g. synchronous to the beginning of a BTL clock cycle or asynchronously) depends on the trigger source used.

3.6.2 External Disturbance Voltage

External disturbance voltage

By default the supply voltage and disturbance voltage are jumpered together in the supply connector. Nevertheless, the disturbance voltage may also be fed in separately.

Cross reference: For the allowable disturbance voltage range: See Technical Data of the CANstress Hardware.

3.7 Disturbance Mode

3.7.1 'Unlimited Number of Disturbances' Disturbance Mode

Disturbance sequence after each trigger

In the 'Unlimited number of disturbances' disturbance mode the defined disturbance sequence is initiated after each (disturbance) trigger. The number of disturbances to be performed is unlimited here.

The disturbance sequence used as a disturbance may be defined on both the bit level and the BTL level.

3.7.2 'Limited Number of Disturbances' Disturbance Mode

Disturbance within defined disturbance cycles

In the 'Limited number of disturbances' disturbance mode a disturbance is repeated for m disturbance cycles (m=1 to 65535, or infinite). For one disturbance cycle the user can configure the number of disturbances n (n=1 to 255) which indicates how many disturbance sequences are initiated per disturbance cycle. A trigger is needed to initiate each disturbance sequence.

Besides specifying the number of disturbances per disturbance cycle, in this disturbance mode the user can also configure the length of the pause p (p=1 to 65535 ms) that should occur after a disturbance cycle has been run (i.e. after n disturbances) and before the trigger condition for the disturbance sequence is evaluated again.

The number of disturbance cycles may be unlimited. However, the number of disturbances in one disturbance cycle is limited to 255.

The pause time is of interest, for example, in applications in which after multiple disturbances a disturbance pause is inserted to allow the network to recover from any error states that may have occurred.

3.7.3 'Continuous Disturbance (while trigger)' Disturbance Mode

Time limited disturbance

In the 'Continuous disturbance (while trigger)' disturbance mode the bus can be disturbed continuously with a selectable disturbance type (dominant, recessive or analog). The disturbance is applied as long as the trigger condition is satisfied. For ex-ample, if the continuous disturbance is initiated by a software trigger with the Edge triggering option, then the disturbance is only performed briefly. On the other hand, if the continuous disturbance is initiated by a software trigger with the Level triggering option, a disturbance is produced until the software trigger is deactivated.

Note: For configurations that can lead to a brief continuous disturbance, a warning message is displayed.

3.7.4 'Continuous disturbance (until stop)' disturbance Mode

Continuous disturbance

The 'Continuous disturbance (until stop)' disturbance mode is an expansion of the 'Continuous disturbance' disturbance mode. Here the bus with a configurable disturbance mode (dominant, recessive or analog) can be disturbed continuously too. The disturbance begins with **Disturbance|Start** and continues until **Disturbance|Stop**.

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3.7.5 'Continuous disturbance (time limited)' disturbance Mode

Continuous disturbance

The 'Continuous disturbance (time-limited)' disturbance mode is an expansion of the 'Continuous disturbance' disturbance mode. In addition to a disturbance mode (dominant, recessive or analog), a duration for the disturbance can be selected. Upon occurrence of a trigger event, the continuous disturbance will be placed on the bus for the specified duration. After the time has elapsed (that is, after the disturbance has been executed), the hardware switches to the "READY" state.

3.8 Disturbance Sequence Wizard

Cteate disturbance sequences

The following disturbance sequence wizards provide support in creating disturbance sequences:

- Disturbance Sequence Wizard for Bit Field Triggering
  ("Disturbance Sequence for Bit Field Trigger" Dialog on page 41)
- Disturbance Sequence Wizard for Disturbance Message
  ("Disturbance Message" Dialog on page 42)
- Disturbance Sequence Wizard for disturbance sequence
  ("Disturbance Sequence" Dialog on page 42)
- Disturbance Sequence Wizard for error frame
  ("Error Frame" Dialog on page 43)

Note: (valid for "Disturbance Sequence Wizard for bit field triggering" and "Disturbance Sequence Wizard for disturbance message"):

Only the dominant and recessive disturbance states may be used within the wizards.

After exiting the wizards with [OK] the entries are copied over to the "Disturbance sequence" input box. Since the entries within the wizards do not contain any stuff bits, while the actual disturbance sequence does contain stuff bits, the entries made within the wizards are provided with stuff bits accordingly. In doing so, consideration is given to stuffing bits only in the range between the Start of Frame and the CRC Sequence (including both of these).

If BTL cycles was selected as the resolution on the "Disturbance" page before calling the wizard, when the wizard is exited the bit disturbance sequence that was created is converted to BTL cycles. This is based on the BTL cycles per bit value configured in the "Channel Configuration" dialog.

Within the Disturbance Sequence Wizard empty input fields lying between the Start of Frame and the input field with the last entry are filled up with recessive disturbance bits.

3.9 Configuration

Process of trigger and disturbance

The triggering and disturbance processes are controlled by the user-defined configuration.

The configuration is determined by various parameters:

- Configuration of the trigger source for the disturbance

  Configuration of the trigger source defines the circumstances under which the disturbance trigger should be initiated.

- Configuration of the disturbance mode

  Configuration of the disturbance mode defines the type (e.g. continuous disturbance) and duration (e.g. once or infinite) of the disturbance.

- CAN Parameters

  The parameters 'Bus Timing Register 0' and 'Bus Timing Register 1' are used to define the baud rate, the number of BTL cycles per bit, and the sampling point within a bit. (Use the "CAN Parameters" command ("Options" menu) to open the "Channel Configuration" dialog, in which these parameters can be defined.)

- CAN Interface

  The CAN Interface option specifies which hardware interface is used to establish a connection with the CAN bus. (Use the "CAN Interface" command ("Options" menu) to open the "CAN Interface" dialog in which these options can be defined).

- CAN Database

  The same database used as the basis for selecting messages is also needed to display symbolic message names (e.g. the name of the message on whose identifier bit field triggering should trigger).

A CANstress configuration is saved in a file with the filename extension CST.

3.10 Establishing a Connection

3.10.1 Via USB port

USB port

If a CANstress hardware is connected to the PC via USB the connection is established via USB. This connection has a higher priority than the connection via the serial RS-232 port. For the USB port no connection parameters must be set.

3.10.2 Via serial RS-232 port

RS-232 port

For the most part the CANstress software handles the connection process autonomously. The only parameters needed are the serial port to be used and the baud rate, which are input in the "Connection Parameters" dialog (Use the "Connect" command ("Options" menu) to open the "Connection Parameters" dialog).

The status of the momentary connection state can be seen on the status bar.

If problems occur while establishing a connection between the CANstress software and the hardware, you should check the following:

- Is the CANstress hardware operationally ready?
- Is a serial cable being used for the connection between the computer and the CANstress hardware? A so-called NULL modem cable is unsuitable for this purpose.
- Is the serial port already being used by another application? In this case the other application must be closed.

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Note: For applications in a MS-DOS shell it is often insufficient to just exit the application. Usually the serial port is not made available until the MS-DOS shell is closed.

➔ Is the port selected in the "Connection Parameters" dialog available in the system?

Some interface cards (e.g. graphic cards) with a PS2 mouse reserve the interrupt sources used for the serial ports by default. If the computer has such a card, the interrupt allocations should be checked under the system settings on the control panel.

3.11 Working with CAN Databases

Create, edit and assign databases

CANstress supports working with CAN databases. CAN databases contain assignments between message identifiers and symbolic message names as well as signals which symbolically describe data segments within messages. CAN databases can be created and edited in the form of CANdb databases with the help of the CANdb Editor.

The CANdb database must be associated to the CANstress configuration to make it possible to use the information from the CAN database within CANstress. (Use the "Associate database" command ("File" menu) to associate one or more databases to the active CANstress configuration.)

The messages contained in the associated CANdb databases can be used to formulate both a bit field trigger condition and a disturbance message.

Note: If a DBC database is associated to a configuration, the message name is displayed whenever possible after "Symb. ID:" located beneath the "Arbitration Field" input box on the "Bit field trigger" page.

4 CANstress Hardware

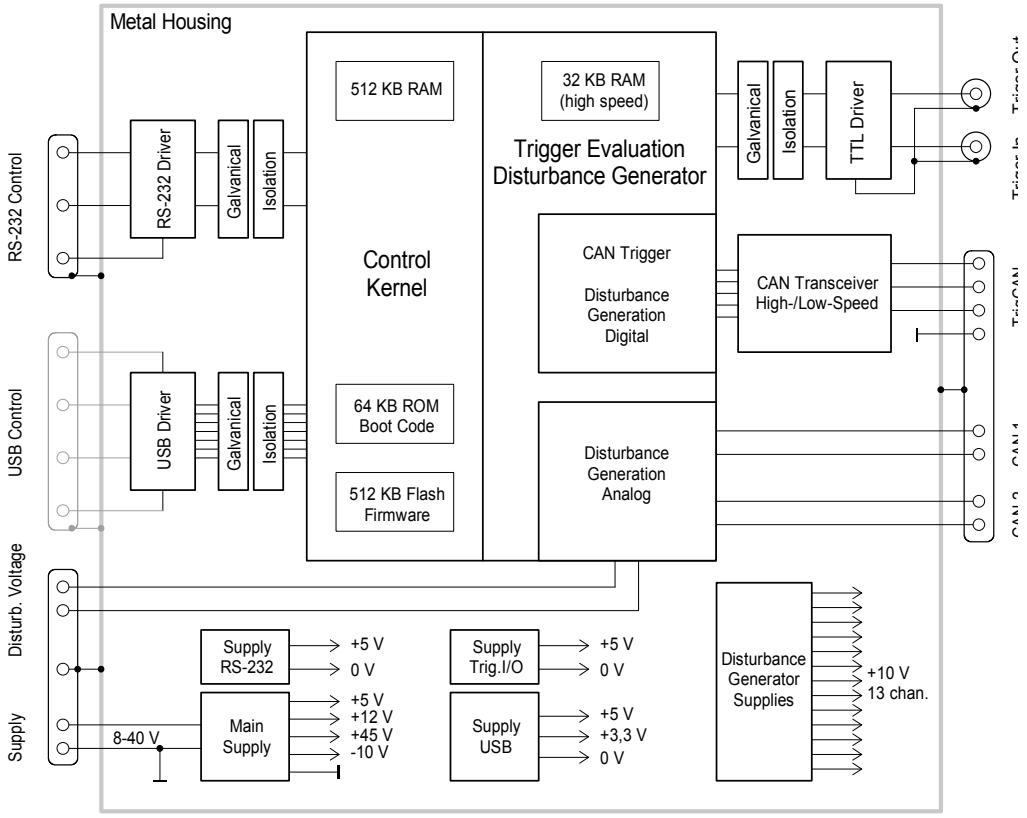
In this chapter you find the following information:

4.1 Block Circuit Diagram

Construction CANstress hardware

The block circuit diagram (compare Figure 4) clarifies the basic construction of the CANstress hardware as well as the following actions taken to achieve electrical isolation of the various system components:

- The negative pole of the supply voltage (GND) represents the reference voltage for the CAN interface (CANGND).
- The fed-in disturbance voltage has its own reference voltage which need not be identical to GND.
- The RS 232 port is electrically isolated from all other components.
- The USB interface is electrically isolated from all other components.
- Trigger input and trigger output utilize a common reference voltage, but they are electrically isolated from all other components.
- There are no connections whatsoever to the metal housing internal to the device.



Block circuit diagram of the CANstress hardware

4.2 Connections

Connections

The electrical connections of the CANstress hardware are fed out via jacks and connectors on the upper front side of the device. All connections can be secured by screws, screw closures or bayonet nut connectors (BNC).

4.2.1 Voltage Supply

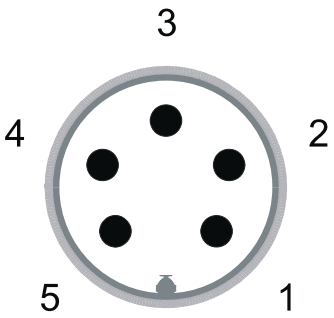
Voltage supply

The supply voltage may lie at any desired voltage between 8 and 40 V DC. Independent of the applied voltage, the maximum power consumption is 8 Watt for the CANstressD and 20 Watt for the CANstressDR. This yields a maximum current consumption of 670 mA (CANstressD) and 1700 mA (CANstressDR) at 12 V or 340 mA and 850 mA respectively at 24 V. The supply input is protected against re-verse polarity and is protected against excessive current consumption by an internal selfresetting circuit breaker.

4.2.1.1 Voltage Supply Connector

Construction

The voltage supply connector of the CANstress hardware has five pins (Binder Series 711).



Supply Connector (view of the connector contacts on the device)

PIN out

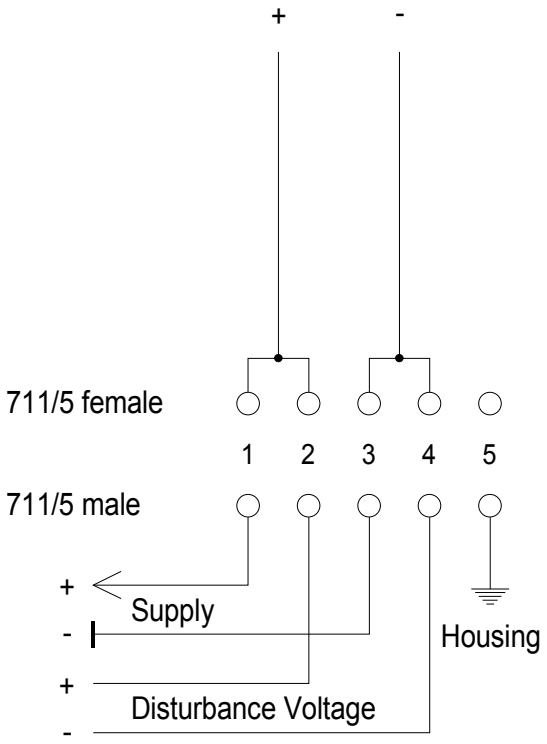
Pin out of voltage supply connector:

PIN	Function
1	Positive pole of supply
2	Disturbance voltage +
3	Negative pole of supply
4	Disturbance voltage -
5	Housing ground

4.2.1.2 Voltage Supply Cable

Construction

In the supply cable provided (see figure, opposite) the connections for supply and disturbance voltages are jumpered together so that the same voltage is used for both purposes.



Supply cable

If a disturbance voltage is applied which deviates from the supply volt-age, these jumpers should be re-moved at the connector, and one or two additional lines should be attached for the feed.

Using Pin 5 of the supply connector it is possible to set the housing ground to a defined voltage level. When utilized in a motor vehicle, a direct connection to the negative supply voltage (vehicle ground) presents itself as an option. If relevant to the particular application, it may be advisable to make a connection to the ground conductor of the installation. If Pin 5 is left un-connected (this is the case on the voltage cable provided), no voltage level is applied to the housing.

Maximum disturbance voltage

This entry only applies to devices of the type CANstressDR; it does not affect devices of the type CANstressD.

In the file "CANstress.ini" there is the following Ini entry:

```
[Hardware]
ExactDistVoltage=12
```

`ExactDistVoltage` gives the maximum disturbance voltage that is fed or may be fed to the CANstress hardware. The default entry is 12 (Volt).

The value given as `ExactDistVoltage` is used to calculate loads of resistors R_H, R_HL and R_L on the Analog Board and to decide wither your selected resistor values may be transferred to the hardware, or whether they could potentially result in hardware damage. (See also “Resistor validation “)

If you feed in a different disturbance voltage please observe the following instructions:

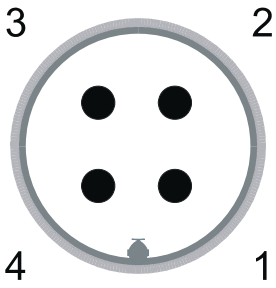
- The maximum allowable disturbance voltage that may be applied to the hardware is 40 V.
- The disturbance voltage you are applying must be entered in the INI entry `ExactDistVoltage`!

Note: You should **never specify a disturbance voltage in the INI entry that is lower than the voltage you actually apply** to the device! Otherwise the hardware might be permanently damaged! Make sure that the INI entry `ExactDistVoltage` is always configured correctly.

4.2.2 USB Port

Construction

The alternative USB port is fed out via a four-pin connector (Binder Series 711) and conforms to the USB High-Speed Standard (12 MBit/s).



USB connector (View of the connector contacts on the device)

PIN our

Pin out of the connector for the USB port:

PIN	Function
1	USB Supply
2	Data line D+
3	Data line D-
4	USB Ground

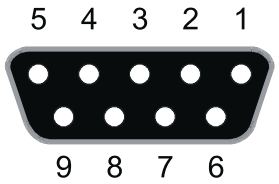
The USB port is also electrically isolated; therefore the pins do not have any electrical connection to other components.

In USB terminology CANstress is 'self-powered'. Therefore no operating current is taken from the USB supply line. These pins only serve to detect whether or not a USB hub is connected.

4.2.3 RS 232 Port

Construction

The port conforms to the RS 232 standard and permits connection to one of the COM ports of a PC via a serial 1:1 adapter cable (DB-9 connector to DB-9 socket).



RS 232 connector

PIN out

Pin out of the connector for the RS 232 control interface:

PIN	Function
2	RS-232 data output
3	RS-232 data input
5	RS-232 ground

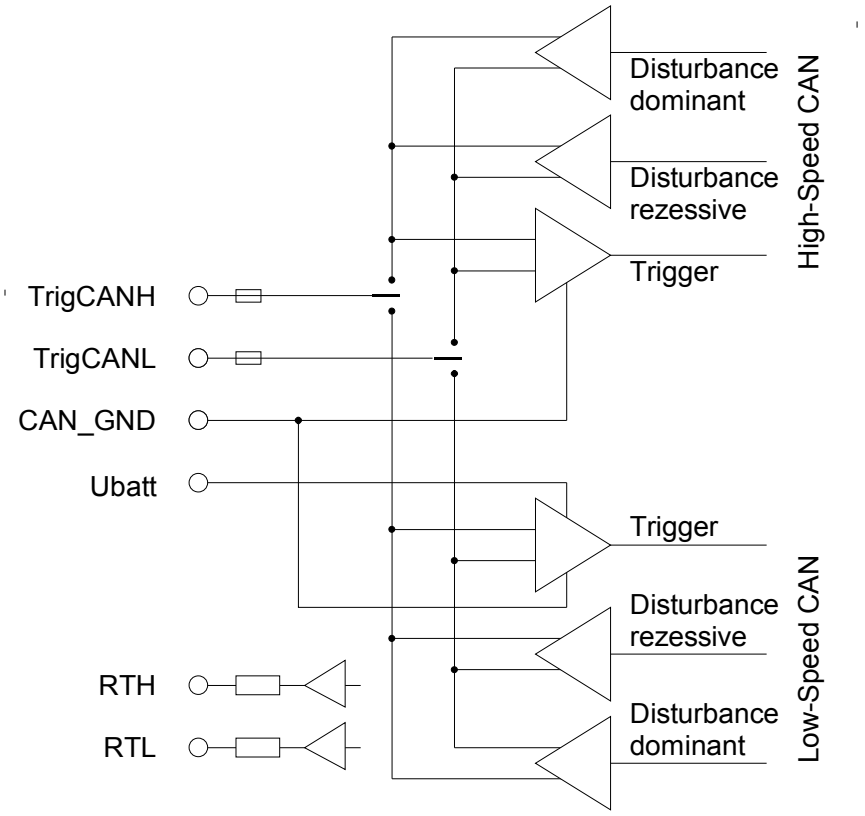
Pins not listed here are not used. Therefore, it is sufficient to connect only pins 2, 3 and 5 to the PC via a three-conductor cable. Please note that due to the internal electrical isolation, Pin 5 ('RS 232 Ground') also has no conductive path to the supply reference voltage.

4.2.4 CAN Interface

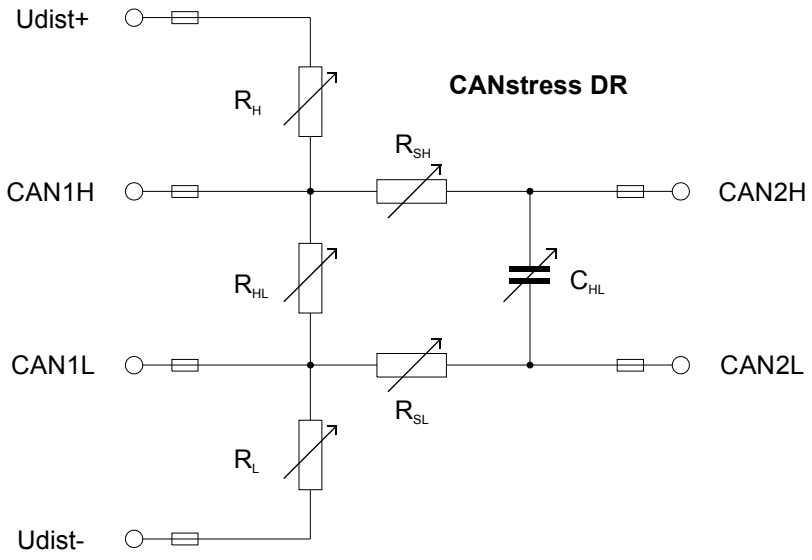
Interface lines

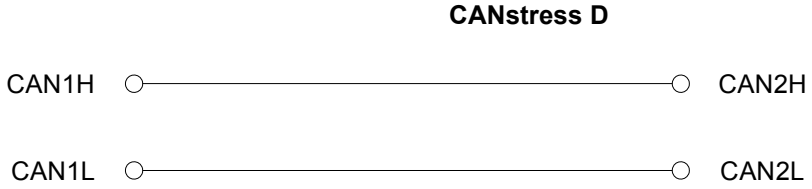
The block circuit diagrams of the CAN interfaces (compare Figure 9) and digital or analog disturbance units (compare Figure 10) clarify the terminal assignments and uses of the externally accessible interface lines.

- The CAN signals for generating trigger events are evaluated via the TrigCANH and TrigCANL connections. The digital disturbance types 'recessive' and 'dominant' are also output over these two connections. In the standard cable TrigCANH is jumpered to CAN1H and TrigCANL to CAN1L.
- CAN_GND represents the reference voltage of the bus signals. If the High-Speed interface is being used, connection of CAN_GND is optional. When using the Low-Speed interface connection of CAN_GND is mandatory.
- The supply voltage for the Low-Speed transceiver is fed in via Ubatt – which acts as the operating voltage for the rest of the transceivers used in the CAN system. Alternatively, Ubatt may be left unconnected, and in this case an internal power supply generates a regulated voltage of +12V for the transceiver supply. Ubatt is not necessary for operation of the High-Speed interface.
- RTH and RTL supply the voltages needed for a Low-Speed bus termination by 1 kΩ internal resistors. If required these connections can be made to the bus lines directly or via supplemental external resistors in the cable connector.
- With CANstressDR, CAN1H and CAN1L represent the inputs and CAN2H and CAN2L the outputs of the analog disturbance unit, consisting of 5 resistor matrices and a capacitor matrix. In the standard cable CAN1H is jumpered to TrigCANH and CAN1L to TrigCANL.
- With CANstressD (no analog disturbances) the input CAN1 is connected through directly to the output CAN2.
- The total of 8 fusible links (2 A) protect the switching FETs from being destroyed in the event of a short circuit (it does not, however, prevent a possible overload of the resistors). If the 50 mΩ additional line resistance resulting from each fuse link is not desired each fuse can be jumpered to adjacent solder pads by means of a soldering jumper.



Block circuit diagram of the CAN interface



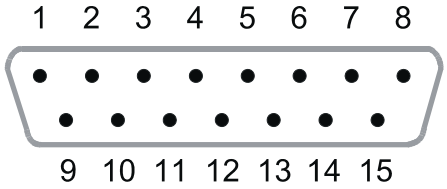


Block circuit diagram of the digital or analog disturbance section

4.2.4.1 CAN Interface Connector

Construction

The CAN connector of the CANstress hardware has 15 pins.



CAN connector

PIN out

Pin out of the connector for the CAN:

PIN	Function
1	CAN_GND
2	CAN1L
3	CAN2L
4	CAN_GND
5	CAN1H
6	CAN2H
7	Unused
8	Ubatt
9	RTL
10	TrigCANL
11	CAN_GND
12	RTH
13	TrigCANH
14	CAN_GND
15	Ubatt

4.2.4.2 CAN Connection Cable

Construction

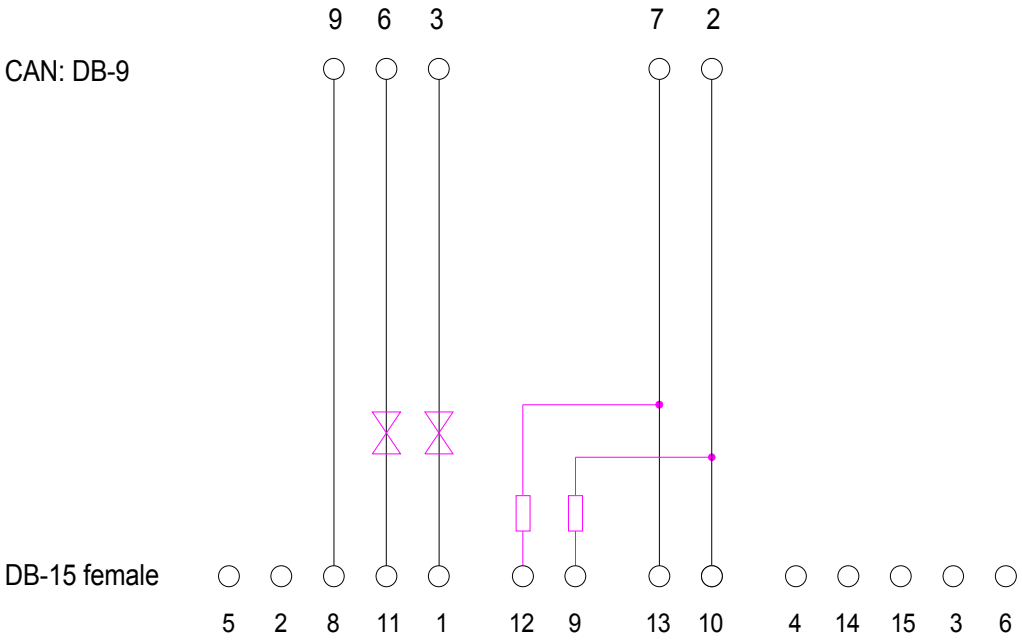
A 60 cm long adapter cable is included with the product for connecting the CANstress hardware to a bus system. It converts the 15-pin connector of the CAN connection to two DB-9 connectors (one connector and one socket each).

PIN out

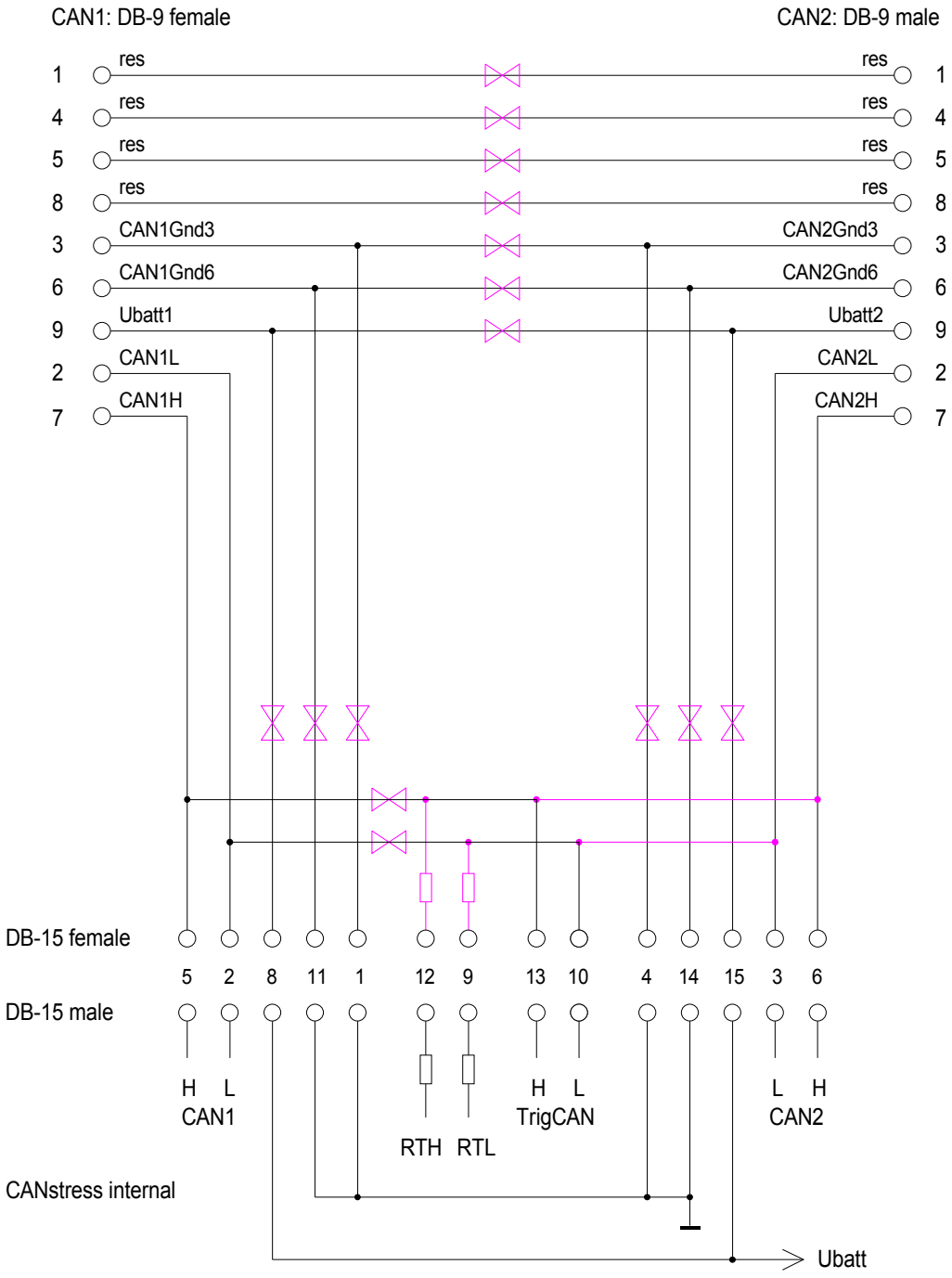
The pin outs of the two DB-9 connectors conform to CIA recommendations.

PIN	Function
2	CAN_L
3	CAN_GND
6	CAN_GND
7	CAN_H
9	Ubatt

The DB-9 pins not listed here (1, 4, 5 and 8) are by convention not assigned to CAN bus signals and are therefore also not connected to CANstress. However, since many installations use these pins for their own purposes, they are fed through the two DB-9 connectors 1:1. As a result, with the help of the adapter CANstress can be "spliced" into CIA-conformant wiring at any desired point of the bus line.



Layout of the simplified cable for connecting a CANstressD to the CAN bus

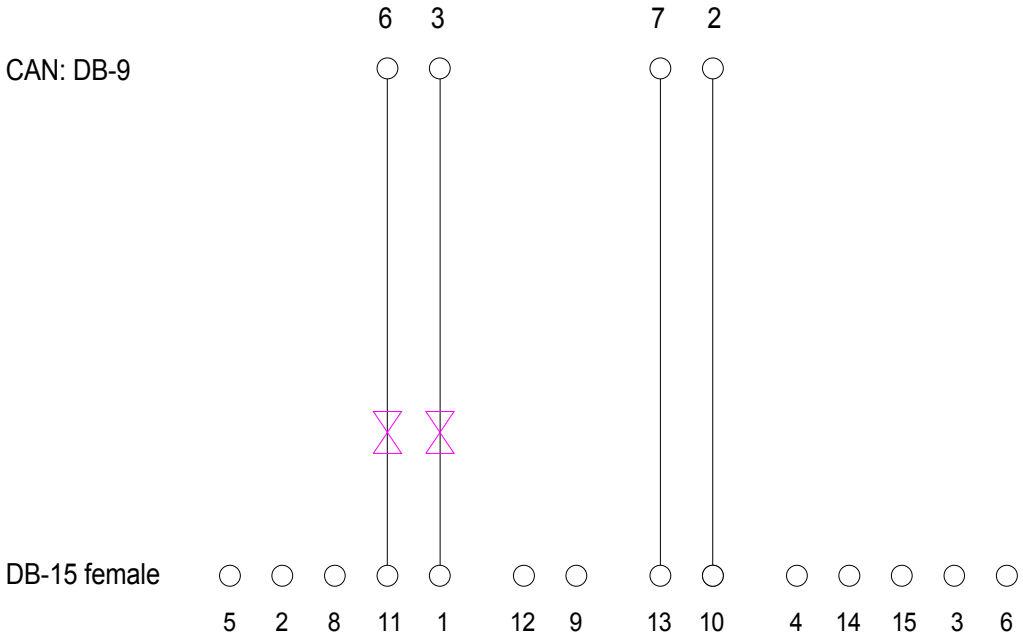


Connection provided in the standard cable

May break connection corr. to user-specific cable configuration

Additional connection corr. to user-specific cable configuration

Layout of the standard cable for connecting the CANstress hardware to the CAN bus



Layout of the simplified cable for connecting a CANstressDR to a High-Speed bus.

4.2.4.3 CAN Low-Speed Adapter

Construction

According to most low-speed CANtransceivers' (e.g. TJA1054) datasheets, a bus connection of 500 Ohm to 16 kOhm is required.

For low-speed CAN, the recessive level can be created with 2 terminating resistors RTH and RTL. These resistors exist on each node.

Thus the resulting terminating resistance is equal to the parallel connection of all these resistances.

The transceiver datasheet now prescribes a max. and min. resistance RTH/L(max,min): RTH/L(max) = 16kOhm; RTH/L(min)=500 Ohm.

CANstress has incorporated 2 resistors with 1kOhm, which are normally not activated since they can have a disturbing effect on high-speed CAN.

If CANstress (without low-speed adapter) is connected to a CANbus that has an extremely high terminating resistor, e.g. only 1 single CANcab (4.7 KOhm), then it is possible that due to the high total resistance within the permissible time (depending on baudrate, bus capacity), no sensible recessive level is created and the transmission will fail.

In this case, the total resistance must be lowered, which can be achieved with the activation of the CANstress low-speed adapter.

If, by contrast, CANstress is connected to a bus that is already correctly terminated, then the internal resistances are not required. In most cases, they have no disturbing effects.

If, nevertheless, the low-speed adapter is used, the total resistance reduces itself accordingly. If may not fall below the 500 Ohm mentioned above.

Conclusion

In general, when using CANstress on a low-speed bus, the use of the low-speed adapter is recommended.

In special cases in which the additionally-connected CANstress on the bus should attract as little attention as possible, however, the LS adapter should not be used.

4.2.5 Trigger Input

Functions

The trigger input is designed as a BNC socket and can assume the following functions by configuration at the user interface:

- Switched off:
  The input is non functional.
- External trigger:
  A trigger signal is fed in - the user can select triggering on a falling edge, rising edge, HIGH level or LOW level. This signal is OR'd with any other enabled trigger sources.
- Trigger enable:
  Functionality of the remaining activated trigger sources is enabled/disabled by HIGH or LOW level.

The trigger input is laid out as a TTL input and is provided with a pull-up resistor which fixes the level to HIGH when the input is open. The BNC housing is at logical LOW (0 Volt) so that it is also possible to connect a passive switch. Closure of this switch then generates a falling edge.

A self-resetting circuit breaker (100 mA) prevents damage to the input if voltages are applied which lie outside of the allowable TTL range.

4.2.6 Trigger Output

Control other evaluation systems

The trigger output is similarly designed as a BNC socket and serves to control other evaluation systems with CANstress trigger information.

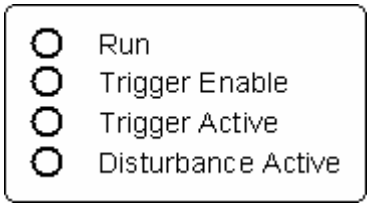
The reaction of the trigger output can be programmed independent of disturbance generation. The active level is logical HIGH.

Here too the BNC housing is at logical LOW (0 Volt) and is conductively connected to the BNC housing of the trigger input. There are no electrical connections to other components.

4.3 LED Indicators

Status information

In normal operation the LEDs of the CANstress hardware indicate the following status information:



LEDs of the CANstress hardware

LED	Status information
Run	Operational indicator (flashes continuously)
Trigger Enable	If this LED illuminates, triggering of the disturbance system is enabled (externally). If it was configured at the user interface that the trigger input should not be used as an enable signal, this LED illuminates continuously.
Trigger Active	If this LED illuminates the next trigger will initiate a disturbance.
Disturbance Active	If this LED illuminates a disturbance is currently being generated.

Device errors

Immediately after activation any device errors are indicated as follows:

- All LEDs continuously off:
  No supply. Either no supply voltage is being provided or the power plug is defective.
- All LEDs illuminate continuously:
  Supply exists but device is defective.
- LED 'Disturbance Active' flashes, all other LEDs off:
  Device self-test detected a fault.

Other indicator options outside of normal operation:

- All LEDs flash together at 5 Hz:
  The Bootstrap Mode is active. If this occurs autonomously after power-up, then there is no valid operating software ('Firmware') in the Flash-ROM. The operating software must be installed.

4.4 Hardware States

States:

The CANstress hardware can assume the following states:

IDLE

In the **IDLE state** the hardware is deactivated for triggering and disturbing. This state is reached when the user ends an active disturbance with the "Stop" command ("Disturbance" menu).

ARMED

In the **ARMED state** the hardware is activated for triggering and disturbing. This state is reached when the user starts a disturbance with the "Start" command ("Disturbance" menu).

READY

The **READY state** is reached when the configured number of disturbances has been performed. The hardware is therefore deactivated for disturbing. The hardware for triggering continues to be activated.

4.5 Technical Data

4.5.1 General Technical Data

Parameter	Conditions	Min.	Typ	Max.	Units
Ambient temperature (Operation)		-10		70	°C
Ambient temperature (Storage)		-40		85	°C
Total weight	CANstressD	770			g
	CANstressDR	990			g
Dimension (length x width x depth)	Aluminum case	151x168x53			mm
	Total	163x172x57			mm

4.5.2 Voltage Supply

Parameter	Conditions	Min.	Typ	Max.	Units
Supply voltage		8		40	V
Power consumption	CANstressD		4,5	8	W
	CANstressDR		10	20	W
Current draw at U_{in} = 12 V	CANstressD		375	670	mA
	CANstressDR		850	1700	mA
Fuse protection (self resetting)			4		A
Disturbance voltage between Udist+, Udist-	CANstressDR	-48		+48	V
Udist+ to Ground of the supply	CANstressDR	-8		+40	V
Udist- to Ground of the supply	CANstressDR	-8		+40	V

4.5.3 CAN Interface

4.5.3.1 Operation of the CAN High-Speed Interface

Parameter	Conditions	Min.	Typ	Max.	Units
CAN data rate		5		1000	KBit/s
Voltage at TrigCANH, Trig-CANL, CAN1H, CAN1L, CAN2H, CAN2L to CAN_GND		-8		+40	V
Ditto, disturbance function not assured		-40		+40	V
Diff. input resistance		20		100	kΩ

4.5.3.2 Operation of the CAN Low-Speed Interface

Parameter	Conditions	Min.	Typ	Max.	Units
CAN data rate		5		125	KBit/s
Voltage at TrigCANH, TrigCANL, CAN1H, CAN1L, CAN2H, CAN2L to CAN_GND	Specified functionality	-8		+27	V
Voltage at TrigCANH, TrigCANL, disturbance function not assured	Unlimited	-10		+27	V
Dito	t<0,1 ms, Ubatt>0	-40		+40	V
Voltage at CAN1H, CAN1L, CAN2H, disturbance function not assured	Unlimited	-40		+40	V
Internal resistances at RTH, RTL		950	1000	1050	Ω

4.5.4 CAN Disturbance Section

Parameter	Conditions	Min.	Typ	Max.	Units
Output current CANH/CANL 'dominant' digital disturbance (CAN transceiver)	CAN High-Speed			200	mA
	CAN Low-Speed			100	mA
Output current CANH/CANL 'recessive' digital disturbance	CAN High-Speed			2000	mA
	CAN Low-Speed				mA
Adjustment range: Resistor matrix		0		10237	Ω
Step-width: Resistor matrix			2,5		Ω
Accuracy (referenced to adjusted value)		0,1			%
Adjustment range: Capacitor matrix		0		15750	pF
Step-width: Capacitor matrix			250		pF
Accuracy: (referenced to adjusted value)		1			%
Continuous current: FET switch	Unlimited			2	A
Continuous current: Relay	Unswitched			1,2	A
Switching current: Relay				0,5	A

Parameter	Conditions	Min.	Typ	Max.	Units
Pulsed current: FET switch, relay	t<5 ms, 5% duty			6	A
Loading of matrix resistors (per individual resistor of a matrix)	Unlimited			0,5	W
Ditto, pulse loading	t<5 ms, 1% duty			20	W
Fusible links in CAN1H, CAN1L, CAN2H, CAN2L, TrigCANH, TrigCANL, Udist+, Udist-			2		A
Resistance of fusible links				50	mΩ
Contact resistance: Relay				150	mΩ
Contact resistance Individual FETs			42	50	mΩ
Contact resistance: Double FET switch			84	100	mΩ
Isolation resistance of FETs		2	10		mΩ
Min. pause between disturbance cycles					

4.5.5 RS 232 Interface

Parameter	Conditions	Min.	Typ	Max.	Units
Output level: TxD	'Start' level	+5	+8	+15	V
	'Stop' level	-15	-8	-5	V
Input level: RxD	'Start' level	+2,4		+30	V
	'Stop' level	-30		+0,8	V
Input resistance: RxD		3	5	7	kΩ
Data rate		9600	115200	115200	KBit/s
Isolation voltage to supply		500			V
Isolation voltage to Trigger I/O		1000			V

4.5.6 Trigger Input

Parameter	Conditions	Min.	Typ	Max.	Units
Threshold voltage: HIGH		2			V
Threshold voltage: LOW				0,8	V
Input current HIGH	U_{in} = 5 V			40	µA
Input current LOW	U_{in} = 0 V			2,7	mA
Continuous current limiting (thermic)			100		mA

Parameter	Conditions	Min.	Typ	Max.	Units
Isolation voltage to supply		500			V
Isolation voltage to RS 232 connection		1000			V

4.5.7 Trigger Output

Parameter	Conditions	Min.	Typ	Max.	Units
Output voltage HIGH		2,4			V
Output voltage LOW				0,6	V
Output current HIGH	U_{out} >= 2,4 V			10	mA
Output current LOW	U_{out} <= 0,6 V			16	mA
Continuous current limiting (thermal)			100		mA
Isolation voltage to supply		500			V
Isolation voltage to RS 232 port		1000			V

5 CANstress Messages

In this chapter you find the following information:

5.1 Overview of CANstress Messages

Message	**Please check the hardware connection: CANstress hardware is not connected!**
Possible cause	Different hardware (e.g. a CANscope) was inadvertently connected to the serial port cable of the CANstress hardware.
Remedy	Disconnect the interface cable from the incorrect hardware and connect the CANstress hardware.
Message	**The system could not find the specified file.**
Possible cause	An invalid interface was selected in the "Connection Parameters" dialog (e.g. COM 2 although only COM 1 is available).
Remedy	In the "Connection Parameters" dialog select the port to which the CANstress hardware is connected. (Use the "Connect" command ("Options" menu) to open the "Connection Parameters" dialog.)
Message	**Unable to find the CANdb Editor in the specified directory.**
Possible cause	The CANdb Editor cannot be started, because the installation path of the CANdb Editor was not entered in the `Path=` line of the `[CANdb]` section of the CANstress.INI file, or an incorrect path was entered.
Remedy	Enter the path in which the CANdb Editor is installed in the `Path=` line of the `[CANdb]` section of the CANstress.INI file.
Message	**The active configuration could result in damage to resistors RH, RHL or RL.**
Possible cause	Resistor values were selected in a way that could result in damage to the resistor. (The configuration was not transferred to the CANstress hardware, and the trigger and disturbance system was not activated.)
Remedy	Activate the "Analog disturbance" page of the CANstress program window and select the command "Valid RH", "Valid RHL" and/or "Valid RL" to have valid values determined for these resistors.
Message	**Unable to establish connection to disturbance module.**
1. Possible cause	The CANstress hardware is not powered up.
1. Remedy	Power up the CANstress hardware.
2. Possible cause	The CANstress hardware is not connected to the serial port that was selected for the CANstress software in the "Connection Parameters" dialog.
2. Remedy	In the "Connection Parameters" dialog select the port to which the CANstress hardware is connected. (Use the "Connect" command ("Options" menu) to open the "Connection Parameters" dialog.) Then establish the connection to the CANstress hardware with the "Connect" command ("Disturbance" menu).
3. Possible cause	No disturbance module is connected to the computer on which the CANstress software was started, i.e. no CANstress hardware is connected.
3. Remedy	Connect a disturbance module to the computer.

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Message	**Access denied.**
Possible cause	The serial port over which a connection should be made to the CANstress hardware has already been opened, i.e. it is being used by another application.
1. Remedy	Connect the CANstress hardware to a different port and select this port in the "Connection Parameters" dialog. (Use the "Connect" command ("Options" menu) to open the "Connection Parameters" dialog.)
2. Remedy	Close the other application that is using this port.

6 FAQ

In this chapter you find the following information:

6.1 FAQ Overview

FAQ: How can triggering of a disturbance be delayed?

Solution

Essentially a disturbance can be initiated with a delay by utilizing bits or BTL clocks - depending on the configured resolution - with the Undisturbed disturbance state at the beginning of the disturbance sequence.

For example, if there should be a wait of two bit times after triggering before outputting the disturbance sequence, a disturbance sequence is formulated that begins with 'uu...'. This applies if working with bit resolution. However, if working with a resolution on the BTL level, the number of BTL cycles per bit time would have to be considered. For example, if a setting was made in the "Channel Configuration" dialog indicating that one bit time consists of eight BTL cycles, the disturbance sequence definition would begin accordingly with 16 Undisturbed disturbance states.

If you use bit field triggering for the disturbance sequence, this can also be delayed by using don't care bits at the end of the bit field trigger condition. The advantage of delaying the disturbance sequence with don't care bits is that it is not necessary to consider any stuff bits that might occur, since the hardware automatically removes them in the evaluation.

For example, if the CRC delimiter for the message (with DLC=2) whose 1st data byte begins with '0101' should be disturbed, the user would input '0101 xxxx' for the 1st data byte and specify all bits up to (but not including) the CRC delimiter as don't care bits. Disturbance of the (recessive) CRC delimiter would be made by a disturbance sequence consisting of one dominant bit.

If in this case (disturbance of the CRC delimiter for a specific message with the contents '0101' in the 1st data byte) the user wanted to achieve the delay by using Undisturbed bits in the disturbance sequence, the user would formulate the bit field trigger condition such that it ends after specification of '0101' in the 1st data byte. But then it would be necessary to determine all stuff bits after the occurrence of '0101' (if this were even possible) and also assign them an Undisturbed disturbance state in the disturbance sequence.

It is apparent that here the use of bit field triggering with don't care bits at the end is significantly easier to handle.

Cross reference: See Sample Configurations: Disturb-CRC-Delimiter.cst.

FAQ: Why is it that a user cannot define a bit field trigger condition that contains a 'don't care' bit in the IDE input box and after the IDE bit yet other specified bits?

Solution

This is because the hardware - if it uses the bit stream after the IDE bit for evaluating a trigger condition - needs to know how the bit stream should be interpreted (i.e. whether the next bit should be interpreted as the 1st bit of the Extended ID or as the R0 bit of the Control Field).

FAQ: Why is it that on the "Bit Field Trigger" page a user can input in Stan-dard format (Extended format) only 'dominant' and 'don't care' (only 'recessive' and 'don't care') as a trigger condition for the IDE bit field?

Solution

Entry of the IDE bit on the "Bit field trigger" page informs the hardware how it should interpret the bit stream. The interpretation is defined by selecting the format using the frame format options.

Since the Extended and Standard formats differ in layout after the IDE bit, a don't care bit may only be used in the IDE field if the trigger condition ends with the IDE field.

FAQ: How can I directly disturb a stuff bit?

Solution

For example, if you want to disturb the stuff bit that occurs when a message contains '0101 1111' in its 1st data byte enter this value (for the desired frame format) in the 1st data byte and jump to the next input field using the TAB key. This automatically fills all input fields before the 1st data byte with don't care bits (or with the appropriate care bit in the IDE Field). Activating the "Disturb possible stuff bit" option causes the specified disturbance sequence to affect the stuff bit. Otherwise, if the "Disturb possible stuff bit" option is deactivated, the hardware waits for the occurring stuff bit before it sends the disturbance onto the bus.

Cross reference: See Sample Configurations: Disturb-Stuff-Bit.cst

FAQ: Why is it that a user can input a DLC greater than 8 on the "Bit Field Trigger" page?

Solution

Although a DLC greater than 8 is not permitted per CAN specification, a DLC greater than 8 may be entered on the "Bit field trigger" page.

DLCs greater than 8 can be used to check whether the specified DLC actually does not occur (in this case triggering never occurs).

FAQ: How should the trigger condition be interpretted that contains 'xxxx' in the DLC, '1xxx xxxx' in the 2nd data byte and don't care bits in the other data bytes?

Solution

The DLC with 'xxxx' specifies first that triggering will occur on all messages regardless of the actual DLC. However, the supplemental trigger condition of '1xxx xxxx' requires that the 1st bit in the 2nd data byte must be a recessive bit. This supplemental condition can only be satisfied by messages whose DLC is at least 2. Consequently, triggering is on messages which have a DLC>=2 and contain a recessive bit in the 1st bit of their 2nd data byte.

FAQ: How do I trigger on all messages with DLCs between 3 and 8 which contain '0011 xx00' in the 3rd data byte?

Solution

This is done by entering 'xxxx' for the DLC and the value ('0011 xx00') for the 3rd data byte. All other data bytes can be filled with don't care bits.

FAQ: How do I trigger on all messages regardless of the message ID, DLC and data fields?

Solution

This is done by filling all bit field trigger fields, including the data fields, with don't care bits. The hardware will not disturb the first bit of the CRC sequence for all messages.

FAQ: How do I trigger on both Data frames and Remote frames with a specific ID?

Solution

Entering the ID in the Arbitration Field first specifies the ID on which triggering should occur. Entry of a don't care bit in the RTR input field specifies that triggering should occur on both Data and Remote frames. However, for the case where the DLC is not equal to 0, the data fields may not be filled with only don't care bits! Namely, if a care bit is entered in a data field, this is a supplemental condition which can only be satisfied by a Data frame!

Cross reference: See Sample Configurations: Trigger-On-Data-And-Remote-Frames.cst.

FAQ: How do I disturb the ACK slot for a group of messages?

Solution

This requires first that a trigger condition be found which describes the group as uniquely as possible. Therefore you should avoid excessive use of don't care bits.

For example, if the group consists of two messages (in Standard format) with the IDs '1000 1000 111' and '1000 1000 110' you would use '1000 1000 11x' as the ID for the trigger condition, since this occurs in both messages and simultaneously excludes many other messages.

When the "Selection of Messages" dialog is used, the trigger condition with don't care bits is determined automatically.

Moreover, the supplemental trigger condition should also be specified as precisely as possible up to the ACK slot, i.e. whenever possible without don't care bits.

In the ideal case this trigger condition will then be unique for the desired group. If the user leaves an empty input field for the ACK slot and deactivates the "Disturb possible stuff bit" option, the ACK slot can be disturbed by a recessive bit in the disturbance sequence.

Cross reference: See Sample Configurations: Disturb-ACK-on-Different-ID.cst.

FAQ: How can I lengthen the error flag of an (active) Error frame to 12 dominant bits?

Solution

This is done by selecting Error frame triggering as the trigger source for the disturbance sequence and indicating that triggering should occur if the error flag exhibits six dominant bits. Six dominant disturbance bits are then given as the disturbance sequence (for bit time resolution).

FAQ: How do I intentionally place a controller in the BUS-OFF state?

Solution

To test whether a controller actually removes itself from the network after multiple faulty transmissions and goes to the BUS-OFF state, the following setup can be created:

Bit field triggering is selected as the trigger source for the disturbance sequence, and the user gives the ID of a message the controller transmits as the trigger condition. Furthermore, the user formulates a disturbance that is known to actually disturb the transmitted message (e.g. by intentionally disturbing the message's DLC or transmitting six dominant bits).

The user selects 'Limited number of disturbances' as the disturbance mode and specifies '32' as the number of disturbances, and '1' as the number of disturbance cycles.

Cross reference: See Sample Configurations: ABSdata-Bus-Off.cst.

FAQ: How do I trigger on End of Frame if there is only one node (Sender) in the network?

Solution

In a network with (at least) two nodes the recessively transmitted bit in the ACK slot is overwritten with a dominant bit by a receiver as acknowledgment of receipt of the message. Following the ACK slot are another 8 recessive bits consisting of the ACK delimiter and End of Frame. An End of Frame can be identified on the bus if - after a dominant bit - 8 consecutive recessive bits occur (an additional 3 recessive bits (Intermission field) must also occur to identify the Bus-Idle quiescent state).

In a network with only one node, on the other hand, the recessively transmitted bit in the ACK slot is not overwritten. It is only possible to predict how many recessive bits must occur after a dominant bit to clearly identify an End of Frame if the CRC sequence for the message is known. If the CRC sequence ends with a dominant bit, then 10 recessive bits (CRC delimiter, recessive ACK slot, ACK delimiter and End of Frame) follow up to the End of Frame. On the other hand, if the CRC sequence ends with four recessive bits, then there are 14 consecutive recessive bits on the bus (4 bits from the CRC sequence, CRC delimiter, recessive ACK slot, ACK delimiter and End of Frame).

Since the CANstress hardware utilizes the number of recessive bits after the occurrence of a dominant bit to detect End of Frame or Bus-Idle, this trigger condition can only be used under certain circumstances in a network with only one node (Sender), since the number of occurring recessive bits to the end of the End of Frame varies (depending on the CRC sequence).

In this case bit field triggering can be used to trigger reliably on End of Frame: To do this, enter 7 recessive bits in the input box for End of Frame and confirm the entry with the <ENTER> key. This causes the prior bit fields to be filled accordingly. The input boxes for the DLC and data fields may be filled, for example, with don't care bits so that triggering will occur on End of Frame for messages of any length.

Cross reference: See also: "Other Trigger" Page on page 28, Triggering on End of Frame / Bus Idle on page 47.

FAQ: How can I test whether a node detects a CRC error?

Solution

This is done by selecting the End Of Frame/Bus Idle trigger or the software trigger as the trigger source for the disturbance sequence. A disturbance message is selected with the help of the Disturbance Sequence Wizard. The user then lets the program calculate the CRC sequence of the disturbance message. Afterwards the user can change, for example, the last bit of the CRC sequence (possibly also removing all subsequent bits). After this faulty CRC bit all further bits of the disturbance message are removed, and the Wizard is exited with **[OK]**.

This disturbance message should cause a receiver to send out an Error frame after the end of the ACK field (i.e. after confirming receipt of the message). This Error frame signals the detected CRC error.

Cross reference: See Sample Configurations: Send-Msg-With-CRC-Error-On-Bus-Idle.cst.

FAQ: How can a check be made to determine whether the bus recovers after a series of disturbances?

Solution

This is done by generating a disturbance sequence and suitable trigger condition. Furthermore, the user should select the 'Limited number of disturbances' disturbance mode and indicate the desired number of disturbances (per cycle) and the number of disturbance cycles. If more than one disturbance cycle is executed, the user can prescribe a pause time (in ms) during which the CAN bus can recover.

Cross reference: See Sample Configurations: Multi-Disturb-With-Pause.cst.

FAQ: Basic configuration errors that cause a non-triggering of the disturbance?

Solution

- → Incorrect physical interface (high-speed/low-speed/single-wire)
- → Incorrect baudrate

FAQ: Why isn't it possible to establish a 115200 Baud connection with my computer?

Solution

At a baud rate of 115200 baud problems may occur in establishing a connection on some computers. In this case the CANstress software automatically sets a suitable baud rate for communications.

FAQ: Why is it that I cannot detect the CANstress generated disturbance on the CAN bus using CANscope?

Solution

If the disturbance generated by CANstress cannot be detected by CANscope in the log, there is presumably an error in the Measurement setup.

First, a check should be made to determine whether the desired trigger source is actually used for the disturbance, or whether the trigger source set from a previous test might still be in use.

Furthermore, the user should check whether the CAN baud rate set in CANstress and CANscope agrees with the baud rate of the CAN bus to be disturbed.

FAQ: How can I quickly change the resistor values on the "Analog disturbance" page?

Solution

The exact value of a resistor can be specified quickly on the "Analog disturbance" page (only available with CANstressDR) by entering the desired value in the input box.

If the user only wishes to set an approximate value for the resistor, the slider above the input box can be used.

Note: The resistor value must be divisible by 2.5 Ω, since otherwise the automatic checking process will fail when the CANstress software downloads the resistor layout to the CANstress hardware.

FAQ: How can I remove the contents of all bit input fields?

Solution

If the user deletes a bit on the "Bit field trigger" page and in the Disturbance Sequence Wizard and then presses the <Tab> or <Enter> key, the contents of all sub-sequent bit input fields are cleared.

FAQ: How can I fill all bit input boxes with don't care bits?

Solution

If the user enters any desired bit in a bit input field on the "Bit field trigger" page and in the Disturbance Sequence Wizard and then presses the <Tab> or <Enter> key, all prior bit input fields are filled with don't care bits (or with the relevant care bit for the IDE field).

7 Appendix A: Address table

Vector Informatik GmbH

Vector Informatik GmbH
Ingersheimer Str. 24
D-70499 Stuttgart
Phone: +49 (711) 80670-0
Fax: +49 (711) 80670-111
mailto:info@vector-informatik.de
http://www.vector-informatik.com/

Vector CANtech, Inc.

Vector CANtech, Inc.
Suite 550
39500 Orchard Hill Place
USA-Novi, Mi 48375
Phone: +1 (248) 449 9290
Fax: +1 (248) 449 9704
mailto:info@vector-cantech.com
http://www.vector-cantech.com/

Vector France SAS

Vector France SAS
168, Boulevard Camélinat
F-92240 Malakoff
Phone: +33 (1) 4231 4000
Fax: +33 (1) 4231 4009
mailto:information@vector-france.com
http://www.vector-france.com/

Vector Japan Co., Ltd.

Vector Japan Co., Ltd.
Seafort Square Center Bld. 18F
2-3-12, Higashi-shinagawa, Shinagawa-ku
J-140-0002 Tokyo
Phone: +81 3 (5769) 6970
Fax: +81 3 (5769) 6975
mailto:info@vector-japan.co.jp
http://www.vector-japan.co.jp/

Vector Korea IT Inc.

Vector Korea IT Inc.
Daeryung Post Tower III, 508
Guro-dong, Guro-gu, 182-4
Seoul, 152-790
Republic of Korea
Phone: +82(0)2 2028 0600
Fax: +82(0)2 2028 0604
mailto:info@vector-korea.com
http://www.vector-korea.com/

VecScan AB

VecScan AB
Lindholmspiren 5
SE-417 56 Göteborg
Phone: +46 (31) 76476-00
Fax: +46 (31) 76476-19
mailto:info@vecscan.com
http://www.vecscan.com/

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